VOLUME VII. No. 4. } JOURNAL OF MYCOLOGY. { ISSUED Aug. 15, 1894.

TREATMENT OF PEAR LEAF-BLIGHT* IN THE ORCHARD.

By M. B. Waite.

[Plates XXXII, XXXIII.]

The experiments here described were carried on in the orchard of the Old Dominion Fruit Company, on the James River, near Scotland, Va. This orchard consists almost exclusively of standard Bartlett pears and contained originally 22,000 trees, of which at least 16,000 are still standing. The trees are now 19 years old and the greater part of them are in fairly good condition, except for pear leaf-blight, which for several years past has defoliated the trees during the month of July. This defoliation in midsummer deprives the trees of the use of their leaves during half of the season, and no doubt seriously interferes with their vigor. The cultivation has been fairly good. The trees were headed very low, and the lower branches, until the past season, extended nearly to the ground, but during the past winter they have been trimmed up. Most of the trees do not make a very strong growth, nor do they continue to grow long into the summer. Only occasionally does the general growth of twigs on a tree exceed 1 foot, and often it is much less. The fact that these trees have been regularly defoliated with leaf-blight made this an excellent place for experiment, particularly because of the availability of uniform blocks of similar trees.

The appearance of the disease in question year after year to about the same extent makes it an easy one to experiment upon. In 1892 five sprayings with the 50-gallon formula of Bordeaux mixture entirely prevented the leaf-blight. The dates of the sprayings were April 28, May 15 and 30, and June 14 and 29. At the time of the first treatment the young leaves were just fairly expanded. The object of the sprayings was simply to prevent the disease on about 160 trees as a part of another experiment of an entirely different character. The spraying was thoroughly done and the treated trees held their leaves to the close of the season and showed scarcely a spot of leaf-blight, while the

* *Entomosporium maculatum* Lév.

rest of the orchard became entirely bare by the 1st of August. It were thought at the time that five treatments were probably more than were necessary. The question then arose as to how few sprayings would be necessary to prevent the disease. It was deemed best, therefore, in planning this experiment to take the standard fungicide and find the least number of treatments that would prevent the disease and the best times for making them. On account of the beneficial results from spraying the experimental trees in 1892, the owners decided to spray the whole orchard in 1893. In doing this the suggestions of the Department were followed quite closely and a record of the work was kept, so that it furnishes an interesting example of the success of the treatment and its cost when done on a large scale.

The work, therefore, may properly be discussed under two heads, (1) an experiment to determine the least number of treatments with Bordeaux mixture necessary to prevent leaf-blight, and (2) an experiment to ascertain the actual cost of treating a large orchard with Bordeaux mixture four times.

TREATMENT TO PREVENT LEAF-BLIGHT.

The plan of the first experiment was as follows: A portion of the orchard was selected which was uniform and where there were few missing trees. Eight plats of 20 trees each (two rows of 10 trees each) were laid off side by side and numbered 1 to 8. A control plat of the same size as the numbered plats, 2 rows wide and 10 rows long, was left at the beginning of the series, and another at the end. Continuing from the second control plat, 8 duplicate plats were laid off and numbered 1^1 to 8^1. A third control plat followed 8^1.

Plats 1 and 1^1 were treated April 24, 1 treatment.
Plats 2 and 2^1 were treated May 1, 1 treatment.
Plats 3 and 3^1 were treated May 15, 1 treatment.
Plats 4 and 4^1 were treated June 1, 1 treatment.
Plats 5 and 5^1 were treated May 1 and 15, 2 treatments.
Plats 6 and 6^1 were treated May 1 and 15 and June 1, 3 treatments.
Plats 7 and 7^1 were treated May 1 and 15 and June 1 and 15, 4 treatments.
Plats 8 and 8^1 were treated June 1 and 15, 2 treatments.

It was desired to determine the most critical time in the treatment of the disease by making one single treatment at different times and observing which one did the most good. The Bordeaux mixture used was the 50-gallon formula, 6 pounds of copper sulphate in 50 gallons of water, with enough lime to neutralize all the copper. To avoid complications only the single strength of the fungicide was tried, and the experiment was limited to ascertaining the dates and the number of treatments. The spraying was superintended by Mr. W. H. Berryman, the manager of the orchard. The first application was made just after the trees had come apparently into full foliage, at which time no leaf-blight had yet appeared. The four treatments of plats 7 and 7^1 were given so as to be sure to prevent the disease, and the others were simply intermediates.

Results.—The orchard was visited and careful notes taken on August 2 and again on October 12. By August 2 the control plats had lost the greater part of their foliage. Scarcely one-fifth remained on these trees, and this was rapidly falling, it being badly affected by leaf-blight. The contrast between unsprayed and the sprayed foliage was very striking. All the sprayed trees, including the single treatments, looked exceedingly well as compared with the controls, except the trees sprayed April 24. These showed but little improvement over the unsprayed controls. The other plats, which had been sprayed once, while appearing to retain full foliage, had begun to shed their leaves. There were fewer spots on the leaves of the trees sprayed May 15 than on those sprayed May 1, and still less on those sprayed June 1. In fact, the latter appeared at that time to be an almost perfectly successful treatment and the plat was scarcely inferior to those which received two or even four treatments. By October 12 the controls and also the plat sprayed early were completely defoliated. All the trees were beginning to shed normally a little, so that slight differences had developed which were not apparent on the first visit. The conclusions from a study of these results are as follows:

(1) The earliest treatments gave the poorest results, and of the single treatments there was an increase in effect up to June 1. Between May 15 and June 1 there was but slight difference.

(2) Two sprayings (on May 1 and 15 or on May 1 and June 1) left so little to be desired that they may be considered sufficient treatment for an orchard. The improvement from the additional third and fourth treatments was very slight and was visible only at the close of the season.

(3) Pear leaf-blight on orchard trees in this section of Virginia does not commence its work early in the season, but is a late-appearing fungus. It develops on the foliage after the leaves are quite mature and continues to multiply after August 1. The attacks of fungi which caused differences to appear between plats 2 to 8 came mostly after August 2, long after the spraying was done, thus indicating that it was the thoroughness with which the trees were covered or the amount of fungicide on them that was important rather than the time when it was applied.

(4) From the results it would seem that the first spraying should be postponed until late in the spring, in order to have the fungicide fresh on the leaves during the first attacks of the disease, but should be made early enough to get ahead of the fungus. The second treatment should be made just ahead of the principal attack of the fungus and late enough so as to last well through the season. A leaf thoroughly sprayed once as late as June seemed to be protected for the rest of the season. The disadvantage of the early treatment is apparently due to the long exposure of the fungicide to the weather before the critical time.

(5) These results indicate that for Virginia the first treatment should be made between May 15 and June 1 or even on the latter date, and for regions farther north at correspondingly later dates; or to state the proposition in general terms, the first spraying should be given from four to six weeks after the trees blossom, and the second treatment should be made one month later.

The question naturally arises whether these results can be relied upon without repetition during a series of years. Of course one would feel much safer if they were repeated at least one season. Pear leaf-blight, however, is well known to be a very regular disease, both as to prevalence and severity, and exceptionally uniform during different seasons. This constant character of the disease makes the conclusions much safer than they would be with almost any other fungous disease.

It may be well to state that these conclusions do not apply to nursery stock or to trees which for any reason make a new growth late in the season. In another part of the orchard in question a block of trees which had been pruned back severely to renew the whole top was sprayed four times, the last treatment being on June 30. These trees made 3 to 5 feet of growth and at the close of the season the last 6 or 8 inches of the more vigorous shoots, which had doubtless grown after the last treatment, were either defoliated or spotted with leaf-blight. From this it is evident that trees putting out new growth require additional sprayings to protect the new leaves as they appear.

TREATMENT OF THE ORCHARD AS A WHOLE.

The orchard as a whole was sprayed with the same strength of Bordeaux mixture as the experimental plats, i. e., the 50-gallon formula. In making the mixture a method of preparing and using a stock solution of copper sulphate was devised, which saved the time required to weigh out and dissolve the copper salt for each separate quantity of the mixture. At the suggestion of the writer the plan has since been tried in New Jersey and New York, and has proved to be a great saving of time where a large amount of spraying is to be done. A barrel holding 50 gallons should be selected and 100 pounds of copper sulphate (large crystals can be used) suspended in a basket or a piece of coarse sacking in the upper part of it. The barrel is then filled with water. In the course of a day or two all the copper will be dissolved. The basket is then removed and more water is added until the barrel is again full. This second addition of water is necessary to fill the space which was occupied by the copper before it was dissolved. Each gallon of this solution will contain 2 pounds of the copper salt. If the copper salt is placed in the bottom of the barrel, it will be dissolved only with difficulty. It should be noted that considerably less than 50 gallons of water is added, owing to the fact that the copper occupies some of the space, but that the final solution of copper sulphate and

water makes the 50 gallons. If a greater or less amount of stock solution is to be made up, the vessel must first be measured and a mark made to indicate the required amount, and then the solution made up to this mark. For example, if 40 pounds of copper is desired in stock solution, do not add 20 gallons of water to it, because the resulting solution would then contain more than 20 gallons, but instead make a 20-gallon measure on some convenient vessel and make the solution up to the 20-gallon mark.

The lime may also be kept ready mixed for use. It should be slaked and run off as a paste, and should then be stored in barrels buried in the ground. A tight barrel should be placed beside the copper sulphate barrel and filled about one-fourth full of the lime paste, and then water should be added until the barrel is nearly full.

In making up the Bordeaux mixture it is only necessary to draw off the required amount of copper solution and pour it into the tank while it is being filled with water. When the tank is nearly full add several pailfuls of the milk of lime, obtained by stirring the lime paste and water together, allowing it to settle a few seconds and then dipping it off. By using the yellow prussiate of potash test* it is easy to determine when sufficient lime has been added. The operator soon learns the correct color of the mixture, and this serves as a guide as to when to make the test. All the material which goes into the tank should be strained through a sieve. In the case in question a sieve was made by tacking a square foot of rather heavy brass wire netting, with meshes 20 to the inch, over the end of a funnel-shaped box.

The spraying outfit used was a 150-gallon hogshead, mounted on a wagon. In it was placed a No. 2 Nixon pump, supplied with two hose, each 24 feet long, and a 6-foot brass tube, with stopcock and Vermorel nozzle. One man drove and pumped while two men directed the spray. As they passed between the rows each man sprayed one side of a row. The brass tubes enabled them to cover the trees thoroughly from the ground, except the tops of a few of the tallest. The nozzles gave a fine, misty spray. The endeavor was to touch every part of the tree with the spray, but only for an instant. It was generally necessary to stop the team a few seconds at a few of the trees, but the greater part of the work was done while the team was moving slowly along. If the trees had been small they could have been covered without stopping. Two outfits as described above were used in the work, and it took twelve days to go over the entire orchard once. It was sprayed four times, the cost of the whole work† being about as follows:

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*This test is simply the addition of a few drops of a solution of ferrocyanide of potassium. This solution is made by dissolving one-half ounce of the substance in 2 or 3 ounces of water, and if on the addition of a few drops to the Bordeaux mixture a brownish color appears, more lime should be added.

† The entire expense of the work herein described was borne by the Old Dominion Fruit Company.

1 white man, at $1.25 per day, 48 days	$60
5 colored men, at 75 cents per day, 48 days	180
2 teams, with wagons, at $2 each per day, 48 days	192
Total labor	$432
Chemicals	70
Wear and tear on sprayers	20
Grand total	$522

It will be seen from the foregoing that the cost of treating one tree four times (estimating 16,000 trees) was 3 cents and 2 mills, the cost of treating one tree once was 8 mills, and the cost of treating one acre (estimating 203 acres) was $2.56.

It is undoubtedly true that the four treatments were more than were necessary, and that two sprayings well done would be all that could be desired, as shown by the experimental plats. In other words, had the facts brought out by the experiment been known at the beginning, the cost of spraying the orchard could have been reduced one-half.

It is important to notice that the principal cost was the labor in applying the mixture, the men and teams costing more than four-fifths of the total amount. The cost of the fungicide and apparatus was a relatively small matter. This suggests that future experiments should be directed toward improving the means of distributing the fungicide, and thereby reducing the amount of labor required.

DESCRIPTION OF PLATES.

PLATE XXXII.—Bartlett pear tree sprayed with Bordeaux mixture.
PLATE XXXIII.—Bartlett pear tree untreated and defoliated by leaf-blight.

EXPERIMENTS WITH FUNGICIDES TO PREVENT LEAF-BLIGHT OF NURSERY STOCK.

By D. G. FAIRCHILD.

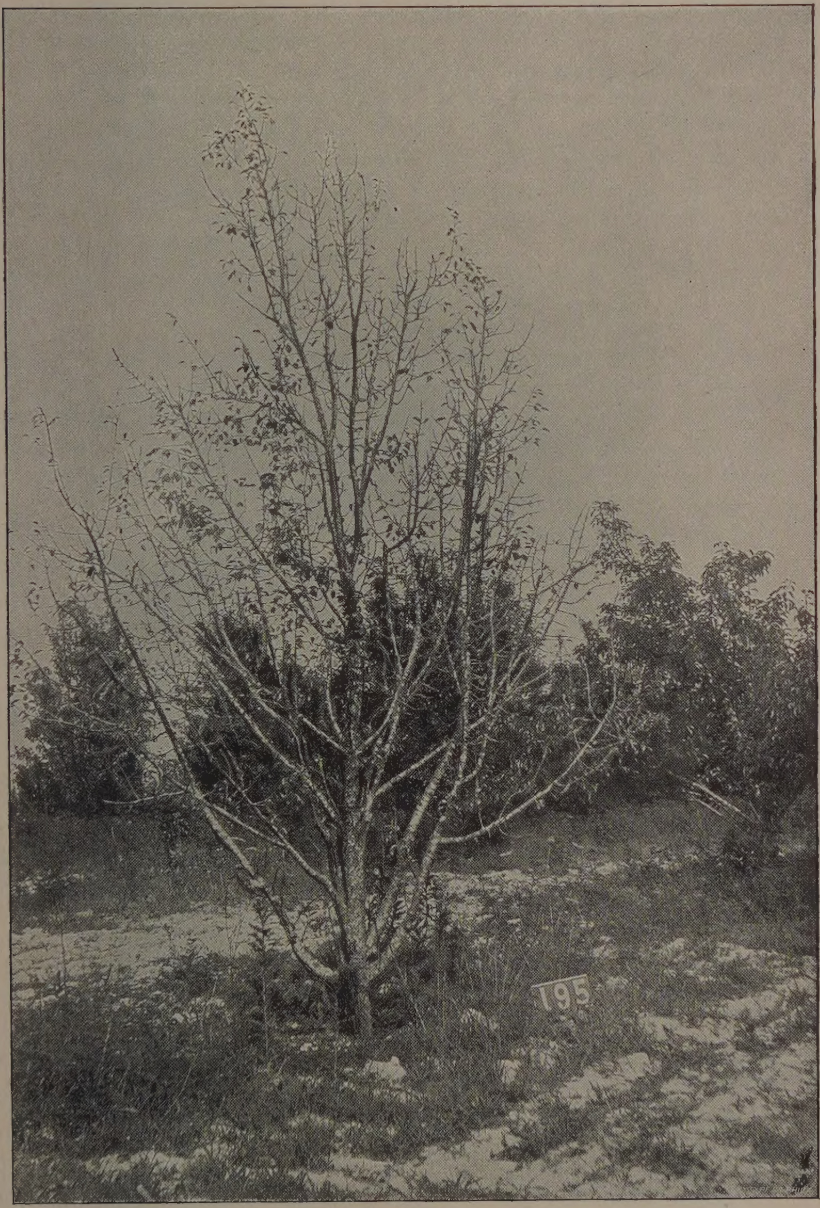
The following paper gives details of experiments carried on at Geneva, N. Y., to prevent leaf-blight of pear and other seedlings. An abstract of the work has already been published,* but in this paper there will be given in detail the various formulæ used, with notes upon chemical reactions and upon the effects of the different substances employed.

EXPERIMENTS WITH PEAR SEEDLINGS.

The experiment with pear seedlings was carried on in coöperation with Prof. S. A. Beach, botanist of the New York State Experiment Station. I wish here to express my thanks to him for his careful attention to the planting and cultivation of the seedlings, for his assistance in their treatment, and for his valuable aid in taking notes upon the results.

* Report of Sec. of Agr. for 1892, pp. 224–229.

BARTLETT PEAR TREE SPRAYED WITH BORDEAUX MIXTURE.



BARTLETT PEAR TREE UNTREATED AND DEFOLIATED BY LEAF-BLIGHT.

The experimental block was situated only a few feet south of the main nursery experiment described in a previous paper.* All rows ran north and south, at right angles to the rows of the main experiment. Each row was 20 feet long and at first consisted of about 250 small seedlings, but these were thinned out until only from 130 to 150 remained.

The seed for the experiment was received, through the kindness of Mr. S. D. Willard, from Vilmorin, Andrieux & Co., of Paris, in February, 1891. It was imported mixed with moist sand and kept in the ice house until April 20, 1892, when it was sown in shallow furrows, 4 inches wide by 2 inches deep, and covered with earth. Over the earth a thin layer of muck was spread.

The fall previous the ground had been sown to rye, which was plowed under in the spring, before planting the seeds. The land had been occupied by potatoes the year before, but no fertilizers had been applied to it. Hence the soil was not in the highest state of fertility, and it is not surprising that in a part of the field only a feeble growth was made by the seedlings. The usual methods of cultivation were employed.

The arrangement of the rows was somewhat irregular, but this was brought about in the attempt to separate all rows receiving like preparations by as much ground as possible. This method of treating duplicate rows has many advantages, and in fact should be considered as essential to the settlement of problems like the one here involved.

A spraying apparatus of my own contrivance was employed, consisting of a small Johnson hand force-pump fastened into a papier mâché pail by means of a thumbscrew. When many mixtures are to be employed this apparatus has several advantages over the knapsack pump, the principal one being the ease with which it can be cleaned. With several feet of hose, rows of considerable length can be very effectually sprayed. The Vermorel nozzle with a lance was employed.

In spraying care was taken that every leaf should be touched. The periods elapsing between the treatments were not long enough, it is believed, to allow the best mixtures to be washed off. In one or two cases it was found that the untreated-adjacent rows had received occasional sprayings and it may be possible that an imperceptible mist was blown upon the control rows oftener than was observable, these being only 3 feet apart. It is believed, however, that this treatment of controls was so slight as not to vitiate the results in any way. The use of screens, made of light cloth or paper, to protect the control rows during treatment, would obviate any such difficulty.

The writer wishes to express his thanks to Messrs. W. T. Swingle and P. H. Dorsett, who assisted him very materially by suggestions and advice in the preparation of the fungicides. The preparations described below were, so far as my knowledge goes, first prepared by the parties above named. Those not mentioned were of my own invention or

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* Jour. of Mycol., vol. VII, pp. 240-264.

had been previously employed by others. Nos. 2, 18, 19, 20, 21, and 22 were first prepared by Mr. Galloway and Mr. Swingle in experiments with wheat rust at Garrett Park, Md.

As it seemed advisable to adopt some arbitrary standard with which a comparison of the different substances could be made, it was decided to take as a standard the proportion of one part by weight of the metal forming the base of the salt to 1,000 parts of water. In the copper preparations it is 1:1,000; in the iron and zinc compounds. 2:1,000. It must not be supposed, however, that these are in all cases chemically accurate, since the substances used were not chemically pure and the water was not distilled. The same conditions prevailing, however, in each preparation it is thought that the comparative strengths are the same. One gallon of water was calculated to weigh 3,783 grams, and 3.78 grams of copper or 7.56 grams of zinc or iron, generally in the form of a sulphate, were used in the preparation of the mixtures. The proportion of the atomic to molecular weight gave the required weight of the salt to be used. In the preparation of the fungicides another point was kept constantly in view, viz, that no substance not in the finest possible state of division should be sprayed upon the seedlings. In order to secure the chemicals in this condition it was necessary to prepare precipitates and apply them before they became dry.

It has been found that dry, insoluble copper compounds, like cupric carbonate, when mixed with water do not split up into their smallest components, and hence do not adhere to the foliage as tenaciously as freshly prepared precipitates of the same substances. As will be inferred from the above, the preparation of each chemical necessitated the use of two or more ingredients, one the salt of the metal and the other an alkaline salt. With four exceptions the substances were all insoluble compounds, and by numerous titrations the optimum proportion of the salt containing the metal to that containing the alkali was established. By optimum is here meant that proportion which gave the lightest and most flocculent precipitate. Of two precipitates of the same salt, other things being equal, that one which remains longest suspended in the water is, according to the writer's idea, best suited for a fungicide. A rapidly settling fungicide is to be avoided if possible.

A test with potassium ferrocyanide was made to ascertain if any cupric sulphate remained in solution. As explained subsequently, there was present in all the mixtures a soluble salt, resulting from the combination of the alkali with the acid of the metal salt. This is indicated by the notes given after the name of the fungicide.

The plan of the experiment was made as simple as possible. Twenty-five substances mixed in water were applied to 50 rows of seedlings, that is, each substance was applied to 2 rows. These rows did not stand side by side, but were separated by at least 60 feet. On each side of every treated row stood an untreated one to serve for compari-

son. Thus 102 rows were planted, 51 standing south of a 5-foot alley, and 51 north. Every other row in the south block was treated, beginning with the second row. Each treatment made on the south block was duplicated upon the north block, rows treated with the same substances being placed as far apart as possible, in no case nearer than 60 feet. All rows were planted with seed from the same lot and as nearly as possible in the same manner. They were given precisely the same normal nursery treatment, being thinned out, hoed, and cultivated as nearly as possible on the same days. The seeds germinated normally and produced "stands" of uniform vigor, and not until the influence of the soil began to make itself felt was there the slightest difference noticeable between any of the rows. The unevenness of the soil, however, soon disturbed this uniformity and proved a more potent factor than the disease, but owing to the arrangement of the rows in duplicate it in no way disturbed the experiment.

The twenty-five chemicals which it was designed to test were all carefully weighed out, and concentrated solutions were prepared during the winter of 1891–'92 in the Department and shipped to Geneva ready to be diluted and applied to the seedlings with a sprayer.

The test of the preparations must be considered as wholly preliminary and designed to form a basis for further investigations. Hence, the fact that a large number of the substances failed to prevent the disease by no means signifies that they may not yet prove to be true fungicides when of a suitable strength. According to the writer's notion, there is one requisite for, and two main limitations to, the preparation of a valuable fungicide. The requisite is that the preparation be a true fungicide and prevent infection from the disease. The limitations are, (1) that the expense of the material and its application, including the element of danger, shall not be greater than the benefit will warrant; and (2) that the effect upon the plant to be protected shall not be injurious. Any substance which fulfils the above requirements and does not overstep the limitations will prove a valuable fungicide.

Before it is possible to thoroughly test preparations with regard to the limitations above mentioned, it is necessary to gain some idea as to what mixtures are likely to be available for use and to eliminate those which from a combination of injurious and nonfungicidal properties are manifestly unworthy of further trials. In the summary the various mixtures have been grouped into three classes, clearly showing which are likely to be valuable.

In designating the different mixtures the exact chemical name of the supposed active salt has been used wherever the composition of such is known, otherwise the less specific title has been given.

The following is a list of the substances used, with the formulæ for their preparation and a statement of their effect upon the seedlings. The term "mixture" is here used in its broadest sense, to include the

whole product of the chemical reaction which takes place when two or more salts in solution are added together. In the majority of cases the mixture was a solution of sodium or potassium sulphate, with an insoluble metallic salt, either copper, zinc, or iron. The remarks upon the effect of the different preparations are designed as an aid to those who may wish to make further trials with them.

In order to get more definite ideas as to the preventive effects of the various preparations, six grades were established. These were arbitrarily chosen as follows: Grade 1, in which were placed all rows in which the injury to the foliage amounted to from 1 to 15 per cent; grade 2, from 16 to 30 per cent; grade 3, from 31 to 50 per cent; grade 4, from 51 to 70 per cent; grade 5, from 71 to 85 per cent; grade 6, from 86 to 100 per cent. The grade in which each row was placed was decided on after a careful examination and comparison by Prof. Beach and myself. It is believed that the comparative injury done by the disease upon the different rows is for all practical purposes shown as faithfully in this way as it could have been if every seedling had been counted and its condition tabulated. The grading was done twice, once on September 2 and again on October 13.

Under the description of each preparation there is given a comparison of each treated row with the two adjacent untreated ones. In order to make a fair comparison the average of the two untreated rows was taken, and with this the treated row was compared.

Mixtures and solutions tested.—In the twenty-five mixtures described below, where not otherwise stated the ingredients were each dissolved separately in 1 quart of water and thoroughly mixed together. The mixture was then made up to 1 gallon, and 1 quart of this was applied to each row of 130–150 seedlings on each of the following dates: (1) June 3–5, (2) June 14 and 15, (3) July 6, (4) July 20, (5) August 1, (6) August 15.

No. 1.—BASIC CUPRIC ACETATE MIXTURE.

(Rows 1 and 1^1.)

11.90 grams of copper acetate (basic refined powder).

Wet up to a thick paste and allowed to stand 24 hours or more before mixing in 1 gallon of water.

Chemical notes.—This refined powder is evidently a tribasic acetate, and, according to Watts' Dictionary of Chemistry, new edition, vol. I, p. 10, has the formula $2CuO, CuA'_2 2aq. = 3CuO, Ac_2O, Ac_2O2aq. = 2(HO, CuA')Cu(OH)_2$. The basic acetate has been used previously (see Div. of Veg. Path. Bull. No. 3, pp. 11 and 65. Also Beucker, Georges. <Prog. Agr. et Vit., Dec. 7, 1890, pp. 510–516.)

Remarks.—This mixture is easier to prepare, covers the foliage as well, and adheres as well as ammoniacal solution. It proved more effective in retarding the progress of the disease and was not injurious. The treated rows were ½ and 2 grades better than adjacent untreated rows on September 2, and 1½ and 1 on October 13. (The number first mentioned, denoting superiority, refers to the original row (1); the second to the duplicate row (1^1).)

No. 2.—COPPER BORATE MIXTURE.

(Rows 2 and 2^1.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

16.39 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).

1 gallon of water.

Chemical notes.—The borate has probably the formula $(Cu_2H)BO_3 + \frac{1}{2}$ aq., which on being decomposed by the water becomes $CuBO_2 . 3CuHO + \frac{1}{2}$ aq. (see Watts' Dictionary of Chemistry, old ed., 1863, p. 643). The substance was used as a dried precipitate by Lodeman,* but it was first proposed in its present form by W. T. Swingle and used for rust of wheat.† The reaction would be represented by the following formula: $CuSO_4, 5H_2O + Na_2B_4O_7, 10\,H_2O = CuB_4O_7 + Na_2SO_4 + 15H_2O$. It is therefore sprayed upon the plant in the form of a copper borate and a sodium sulphate.

Remarks.—This mixture is more difficult to prepare and does not cover the foliage as well, but adheres better than ammoniacal solution. It proved more effective in retarding the disease and was not injurious. The treated rows were 1 and 2 grades better than adjacent untreated rows on September 2, and 2½ and 1 on October 13. It is one of the most promising mixtures as regards efficacy, and might be tried stronger.

No. 3.—COPPER BASIC CARBONATE MIXTURE.

(Rows 3 and 3^1.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

14.90 grams sodium carbonate ($Na_2CO_3 + 10H_2O$).

1 gallon of water.

Chemical notes.—This precipitate when first formed probably has the following formula: $CuCO_3$, CuO_2H_2, H_2O, but it rapidly becomes $CuCO_3$, CuO_2H_2 (see Watts' Dictionary 1888, p. 698). It is the mixture previously known as the "Masson" mixture and is identical with the first compound formed in the preparation of modified eau céleste. The reaction is expressed as follows: $CuSO_4$, $5H_2O + Na_2CO_3$, $10H_2O = CuCO_3 + Na_2SO_4 + 15H_2O$. The preparation, therefore, reaches the plant in the form of a copper carbonate and a sodium sulphate combined.

Remarks.—This mixture is more difficult to prepare than the ammoniacal solution, but it covers the foliage and adheres about as well. It proved more effective in retarding the progress of the disease and was not injurious. The treated rows were 1 and 2 grades better than adjacent untreated rows on September 2, and 3 and 2 on October 13. It is one of the most promising of the new fungicides as regards efficacy and should be tried stronger.

No. 4.—AMMONIACAL COPPER CARBONATE SOLUTION.

(Rows 4 and 4^1.)

7.03 grams cupric basic carbonate (copper carbonate) ($2\,CuO$, $CO_2(OH)_2$).

50 c. c. of water.

150 c. c. of aqua ammonia, 26 per cent (stronger water of ammonia) (NH_4HO.)

1 gallon of water.

The carbonate is wet up in the small quantity of water to a thin paste, and after a few minutes the ammonia is added and the solution thus formed made up to 1 gallon.

Chemical notes.—The reactions for this fungicide, which is the ammoniacal solution as ordinarily used, with the addition of more ammonia than common, have been published by F. D. Chester in the Journal of Mycology, vol. VI, p. 23. A large quantity of ammonia was found necessary to a *complete* solution of the carbonate, but it was highly injurious.

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* Lodeman, E. G. N. Y. Cornell Agr. Exp. Sta., Bull. No. 35, pp. 327, 331.

† Jour. of Mycol., vol. VII, No. 3, May, 1893, p. 201.

Remarks.—This solution was taken as the standard with which the others are compared, although it injured the leaves and necessitated a dilution to 2 gallons. The excess of ammonia necessary to dissolve the carbonate was probably the cause of the injury. The grading was not upon the injury, but only as regards the disease. The manner in which this solution spreads and adheres is well known and forms a basis for comparison. The treated rows were graded 1 and 1, or no better than adjacent untreated rows, on September 2 and 5, and 1 better on October 13.

No. 5.—CUPRIC FERROCYANIDE MIXTURE.

(Rows 5 and 5[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

22.35 grams potassium ferrocyanide (yellow prussiate of potash) K_4FeCy_6, $3H_2O$.

1 gallon of water.

Chemical notes.—A well-defined chemical compound, with the formula $Cu_2Fe_2Cy_6$, with possibly CuK ferrocyanide present (see Watts' Dictionary, *l. c.*, 1889, p. 325). The reactions, however, were not obtainable. It is used ordinarily as a delicate test for the presence of Cu in solution. According to observations of Miss E. A. Southworth, spores of *Cladosporium fulvum* grew luxuriantly in drops of water containing this precipitate. The normal reaction would be as follows: $CuSO_4,5H_2O+K_4FeCy_6, 3H_2O = CuFeCy_6 + K_4SO_4 + 8H_2O$. This would indicate that the substance sprayed upon the plants was a combination of copper ferrocyanide and potassium sulphate.

Remarks.—This fungicide is more difficult to prepare than ammonical solution, but covers the foliage as well and adheres about as well. It proved scarcely more effective, but did not injure the foliage. The treated rows were 1 and 0 grades better than the adjacent untreated rows on September 2, and 1½ and 0 on October 13. Further tests are necessary with a stronger mixture to settle the fungicidal value of this preparation

No. 6.—CUPRIC HYDRATE, BLACK, MIXTURE.

(Rows 6 and 6[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

14.90 grams potassium hydrate (KHO) (caustic potash).

1 gallon of water.

The cupric sulphate and the potassium hydrate in concentrated solutions were mixed and allowed to stand until the mixture became black. Then the whole was made up to 1 gallon.

Chemical notes.—According to Prescott and Johnson (Qualitative Chemical Analysis, 4th ed., 1891, pp. 86–87), the combination formed when $CuSO_4$ and KHO are allowed to stand in contact is represented by the formula $Cu_3O_2(OH)_2$ if the solutions are both concentrated and the KHO is added to saturation. The normal reaction of the two substances as given above will be $CuSO_45H_2O+2KHO = Cu(HO)_2+K_2SO_4+5H_2O$. In the substance sprayed upon the plant there is, therefore, a combination of copper hydroxide and potassium sulphate.

Remarks.—This mixture is more difficult to prepare and does not cover or adhere to the foliage so well as ammoniacal solution. It proved more effective in retarding the progress of the disease and did not injure the foliage. The treated rows were ½ and 1 grades better than adjacent untreated rows on September 2, and 2½ and 0 on October 13. It is a mixture possessing no particular merit, and is markedly inferior to the hydroxide Nos. 7 and 8, but should be tried stronger.

No. 7.—CUPRIC HYDROXIDE MIXTURE.

(Rows 7 and 7[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).

29.80 grams potassium hydrate (KHO).

1 gallon of water.

Prepared in the same way as No. 6, but applied before turning to the hydrate.

Chemical notes.—The original intention was to have the formula as follows: 14.90 grams cupric sulphate, 7.45 grams potassic hydrate, and 1 gallon of water, but by a mistake the KHO was double the amount of cupric sulphate instead of being only one-half the amount. The original would have formed a basic sulphate, since KHO when added short of saturation to $CuSO_4, 5H_2O$ gives a basic sulphate (see Prescott and Johnson, *l. c.*, pp. 86–87). The chemical formula of the hydroxide would be $Cu(OH)_2$, and in addition to the hydroxide present in the mixture there would be potassium sulphate. The reaction is the same as for No. 6.

Remarks.—This mixture is scarcely more difficult to prepare, covers the foliage as well, and adheres about as well as ammoniacal solution. It proved markedly superior in retarding the progress of the disease, but injured the foliage slightly. The treated rows were 0 and 2 grades better than adjacent untreated rows on September 2, and 2 and 2 better on October 13. It is certainly worthy of further trial, and is markedly superior to the black hydrate No. 6.

No. 8.—CUPRIC HYDROXIDE MIXTURE.

(Rows 8 and 8^1.)

14.90 grams cupric sulphate ($CuSO_4, 5H_2O$).
26.82 grams potassium hydrate (KHO).
1 gallon of water.

Prepared exactly as No. 7.

Chemical notes.—This mixture, which was intended for the simple hydroxide, was, because of a mistake in using an increased amount of potassium hydrate instead of a diminished amount (26.83 grams instead of 8.27 grams), applied as a hydroxide, with a large excess of KHO. It differed from No. 6 only in not being allowed to stand and thus become a black hydrate and from No. 7 in having less KHO. The substances in the sprayed mixture were the same as in Nos. 6 and 7, and the reaction would be the same.

Remarks.—In ease of preparation and application and in adhesiveness this mixture is like No. 7. It proved superior to ammoniacal solution in retarding the disease, but injured the foliage slightly. The treated rows were 1½ and ½ grades better than the adjacent untreated rows on September 2, and 0 and 1½ on October 13. It is slightly inferior to No. 7, but superior to No. 6. It differs in composition in no essential way from No. 7, and the difference in result is probably not significant.

No. 9.—TRICUPRIC ORTHOPHOSPHATE.

(Rows 9 and 9^1.)

14.90 grams cupric sulphate ($CuSO_4, 5H_2O$).
26.07 grams sodium phosphate ($Na_2HPO_4, 12H_2O$).
1 gallon of water.

Chemical notes.—The pearly blue precipitate thus formed is in all probability the tricupric salt mentioned in Watts' Dictionary, 1866, p. 560, and having the formula $Cu_3 P_2O_8$. No excess of $CuSO_4$ was observable in the supernatant fluid. The mixture as sprayed upon the plants was composed of copper orthophosphate and sodium sulphate. The reaction can be expressed as follows: $CuSO_4, 5H_2O+Na_2HPO_4,12H_2O= CuHPO_4+Na_2SO_4+17H_2O$.

Remarks.—This mixture is more difficult to prepare, but covers the foliage better and adheres better than the ammoniacal solution. It proved to have more efficiency in retarding the progress of the disease and did not injure the foliage. The treated rows were 1½ and ½ grades better than adjacent untreated rows on September 2, and 2½ and 0 on October 13. It is a mixture worthy of further trial.

No. 10.—CUPRIC POLYSULPHIDE MIXTURE.

(Rows 10 and 10^1.)

14.90 grams cupric sulphate ($CuSO_4, 5H_2O$).
14.90 grams potassium sulphide (K_2S_3 and K_2S_5 with intermediate forms) (liver of sulphur).
1 gallon of water.

Chemical notes.—Necessarily a more or less variable compound from the fact that the liver of sulphur is a variable factor, being composed of tri and penta sulphides, with the intermediate forms. The most probable formula is $Cu_2S_2 + Cu_2S_3 + Cu_2S_4$, or possibly a mixture of Cu_2S and Cu_2S_5 (see Watts, *Ibid.*, 1864, p. 76). Cupric sulphate seems to be present in slight excess, and from the reaction it is evident that this is combined in the solution with potassium sulphate.

Remarks.—This fungicide is only slightly more difficult to prepare, covers the foliage about as well, and adheres better than the ammoniacal solution. It proved inferior to the ammoniacal solution in retarding the disease, and injured the foliage. The treated rows were 1 and 1 grades better than the adjacent untreated rows on September 2, and 1 and 0 on October 13. Although much was hoped for from this mixture when first prepared, the experiment has not shown it to possess any remarkable fungicidal value.

No. 11.—COPPER SUCRATE MIXTURE.

(Rows 11 and 11'.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
14.90 grams cane sugar ($C_{12}H_{22}O_{11}$).
14.90 grams potassium hydrate (KHO).
1 gallon of water.

Cupric sulphate is dissolved in water and the cane sugar is added. The two are heated to boiling and then the potassium hydrate is added. All solutions are strongly concentrated.

Chemical notes.—This mixture proved troublesome to make, from the fact that the "sucrate" if heated too much after the addition of the potassium hydrate became bright red, turning to the red oxide. When properly prepared the mixture is a dark, livid green. The reactions are too complex to be written. Evidently little is known of the exact composition of this peculiar compound, which differs entirely from that formed in the cold. It is not the "copper saccharate" of various French authors.

Remarks.—This mixture is much more difficult to prepare than ammoniacal solution, does not cover foliage any better, and is more easily washed off. It proved less effective in retarding the disease and injured the foliage slightly. The treated rows were 0 and ½ grades better than adjacent untreated rows on September 2, and 1½ and 0 on October 13. It is so complex and difficult of preparation as not to warrant further trial.

No. 12.—COPPER SILICATE MIXTURE.

(Rows 12 and 12'.)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
44.70 grams sodium silicate (Na_4SiO_4 (?)) (Prescott and Johnson, *l. c.*, p. 215, water glass).
1 gallon of water.

Chemical notes.—According to the chemical catalogues, water glass is a pure sodium silicate. No cupric sulphate could be detected in the supernatant fluid. It is a compound of which nothing definite seems to be known. It is not mentioned by Watts. The chemical reaction would be $2CuSO_4$, $5H_2O + Na_4SiO_4 = Cu_2SiO_4 + Na_4(SO_4)_2, + 5H_2O$. According to this the compound sprayed upon the plants would be a mixture of copper silicate and sodium sulphate.

Remarks.—This mixture is slightly more difficult than ammoniacal solution to prepare, covers the foliage about as well, but does not adhere as well. It proved much less effective in retarding the progress of the disease, but was not injurious. The treated rows were 0 and 0 grades better than adjacent untreated rows on September 2, and ½ and ½ better on October 13. It merits further trial only in a more concentrated form.

No. 13.—CUPRIC SULPHATE, AMMONIA, AND SOAP MIXTURE (SOAP EAU CÉLESTE).
(Rows 13 and 13[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
0.75 c. c. aqua ammonia 26 per cent (NH_4HO).
44.70 grams palm soap.
1 gallon of water.

The cupric sulphate was dissolved in water and the ammonia added to it. The soap previously dissolved in warm water was then added and the whole mixture churned until a heavy foam was formed.

Chemical notes.—Palm soap was used as being the most available, but other kinds of soap answer the purpose perfectly. This mixture is remarkable in its property of spreading over the foliage. The waxy cuticle of the pear leaves in no way prevents a complete coating from being formed. It is of indefinite composition and too complex to be determined.

Remarks.—Although more difficult of preparation than ammoniacal solution, this covers the foliage and adheres to it in a manner unsurpassed by any mixture yet employed, to my knowledge. It proved much more effective in retarding the progress of the disease and was not in the least injurious. It was tested upon the foliage of bearing pear trees and showed remarkable efficacy in checking leaf-blight. It was also used upon plum and horse-chestnut seedlings without the least injurious effect. Upon grape foliage it proved somewhat injurious. The treated rows of pear seedlings were 1½ and 1 grades better than adjacent untreated rows on September 2, and 2 and 2 better on October 13. It is the most promising of all the 25 preparations employed. It is believed that the subject of soap mixtures is worthy of more extended investigation than it has hitherto received.

No. 14.—CUPRIC OXYCHLORIDE MIXTURE (FORM A).
(Rows 14 and 14[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
29.80 grams chloride of lime ($CaOCl_2$)(?).
1 gallon of water.

Chemical notes.—A sooty black precipitate, often with a brownish tinge, formed best when both cupric sulphate and chloride of lime are in concentrated solution. The proportions of lime and sulphate are highly important. The addition of a small amount produces a green precipitate (No. 15), while the addition of a greater portion causes it to turn to a sooty black color on standing. Free chlorine seems to be given off in the reaction. No cupric sulphate was detectable in the supernatant fluid. I was not able to determine the composition of this compound and believe little is known of it further than that it is probably an oxychloride.

Remarks.—This mixture is more difficult to prepare and apply than ammoniacal solution, spreads as well, but does not adhere nearly as well. It proved less effective in retarding the progress of the disease and was very injurious to the foliage, scorching it severely and necessitating a dilution to 2 gallons. The treated rows were ½ and 1½ grades better than untreated adjacent rows on September 2, and 0 and ½ better on October 13. It is a mixture with nothing to recommend it.

No. 15.—CUPRIC OXYCHLORIDE MIXTURE (FORM B, TRIBASIC)
(Rows 15 and 15[1].)

14.90 grams cupric sulphate ($CuSO_4$, $5H_2O$).
21.28 grams chloride of lime ($CaOCl_2$) (?).
2 gallons of water.

Chemical notes.—This form of the oxide, according to Prescott and Johnson (*l. c.*), is known in commerce as "Brunswick green," and is used as a pigment. No cupric sulphate was in excess in the supernatant fluid. In Watts' Dictionary, edition of 1889, p. 260, it is stated that Brunswick green has the formula $CuCl_2$, $3CuO$, $4H_2O$.

Remarks.—This mixture is identical in method of preparation with No. 14, and

differs from it only in being slightly less injurious to the foliage. It was diluted 2 gallons. The treated rows were 1½ grades better than adjacent untreated rows on September 2, and 1 and 1 better on October 13. The commercially prepared Brunswick green may not possess the injurious qualities to so high a degree as the freshly prepared precipitate and is worthy of a trial.

No. 16.—COPPER SULPHITE MIXTURE.

(Rows 16 and 16[1].)

14.90 grams cupric sulphate ($CuSO_4, 5H_2O$).

37.25 grams sodium hyposulphite ($Na_2S_2O_3$, $5H_2O$) (U. S. Dispen., 15th ed., p. 1330).

1 gallon of water.

Chemical notes.—Cupric sulphate is in excess in the supernatant fluid. The precipitate settles rapidly, is of a dirty greenish-yellow color, and the proportions of the ingredients have little to do with the rapidity of subsidence of the precipitate. I am uncertain as to its composition.

Remarks.—This mixture, although scarcely more difficult to prepare than ammoniacal solution, covers the foliage no better, adheres no better, and proved very injurious, even after being diluted to 2 gallons. It was, however, more effective in retarding the progress of the disease. The treated rows were 1½ and 1½ grades better than adjacent untreated rows on September 2, and 0 and 2 better on October 13. It is doubtful if the mixture can be modified so as to fit it for use.

No. 17.—FERRIC CHLORIDE AND PHENOL MIXTURE.

(Rows 17 and 17[1].)

36.46 grams ferric chloride ($Fe_2Cl_3 + H_2O$).

36.46 grams phenol (C_6H_5OH) (U. S. Dispen., p. 48) (carbolic acid).

1 gallon of water.

Chemical notes.—This forms a tar-black solution, emitting fumes of carbolic acid. The phenol used was of commercial strength, not crystallized, and equals 20 per cent of the crystallized. The perchloride of iron used has a formula of Fe_2Cl_3, according to Watts, 1865, p. 377, but the amount of water was not obtainable.

Remarks.—This mixture is slightly more difficult of preparation than ammoniacal solution, but extremely disagreeable to apply and highly injurious to the foliage. Dilution to 2 gallons seems to reduce the injury materially. In retarding the progress of the disease it proved less effective than ammoniacal solution. The treated rows were 1½ and 1½ grades better than untreated adjacent rows on September 2, and 0 and ½ better on October 13. It is a mixture altogether too obnoxious to warrant further trial.

No. 18.—FERROUS FERROCYANIDE MIXTURE.

(Rows 18 and 18[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).

45.88 grams potassium ferrocyanide (K_4 $FeCy_6$, $3H_2O$).

1 gallon of water.

Chemical notes.—A light marine-blue precipitate, which becomes dark Prussian blue on exposure to the air. The formula is probably Fe_2FeCy_6, with potassium ferrocyanide present (Watts, 1865, p. 334). The chemical reaction would be Fe_2SO_4, $H_2O + K_4FeCy_6$, $3H_2O = Fe_2FeCy_6 + K_4(SO_4)_2 + 4H_2O$. The ferrous ferrocyanide is therefore combined in the mixture with potassium sulphate.

Remarks.—This mixture is considerably more difficult of preparation than ammoniacal solution, but covers the foliage as well and adheres with remarkable tenacity, far surpassing ammoniacal solution in this respect. It proved less effective in retarding the progress of the disease and was slightly injurious. The treated rows were 1 and ½ grades better than the adjacent untreated rows on September 2, and 0 and 2 better on October 13. It is a mixture seemingly possessing little fungicidal value.

No. 19.—IRON BORATE MIXTURE.

(Rows 19 and 19[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
91.76 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).
1 gallon of water.

Chemical notes.—A steel-gray precipitate, becoming brown or yellow on exposure. Probably a basic salt of uncertain chemical composition (see Watts' Dictionary of Chemistry, 1888, p. 530). The chemical reaction would be written $FeSO_4$, $H_2O +$ $Na_2B_4O_7$, $10H_2O = FeB_4O_7 + Na_2SO_4 + 11H_2O$. The sodium sulphate is in combination with iron borate in the mixture as sprayed on the plants.

Remarks.—This mixture is much more difficult of preparation, covers the foliage no more effectively, and adheres no more tenaciously than ammoniacal solution. It proved almost entirely ineffective in retarding the spread of the disease and was highly injurious, scorching the leaves in a few minutes after application. The treated rows were 0 and ½ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13. It was the most injurious of any of the mixtures employed and has no good qualities to redeem it.

No. 20.—FERRIC HYDRATE MIXTURE.

(Rows 20 and 20[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
11.47 grams potassium hydrate (KHO).
1 gallon of water.

Chemical notes.—The precipitate is of a dirty green color, changing on exposure to a rich brown. The ferrous compound, $Fe(OH)_2$, which is formed on adding potassium hydrate to ferrous sulphate, becomes, on exposure to the air, the ferric compound, $Fe_2(OH)_6$ (see Watts). It is probable, however, that the green ferrous ferric compound was that first formed, as the air was not, of course, excluded from the mixture. The chemical reaction would be $FeSO_4$, $H_2O + 2KHO = Fe(HO)_2 + K_2SO_4 +$ H_2O. The ferric hydrate and potassium sulphate are therefore in combination in the mixture.

Remarks.—This mixture is more difficult of preparation than ammoniacal solution, covers the foliage about as well, and adheres as well, but was slightly injurious. It proved much less effective in retarding the progress of the disease. The treated rows were 0 and ½ grades better than untreated adjacent rows on September 2, and 0 and 0 on October 13. It is doubtful if this mixture has any fungicidal effect whatever.

No. 21.—IRON SULPHIDE MIXTURE.

(Rows 21 and 21[1].)

22.94 grams ferrous sulphate exsiccatus ($FeSO_4$, H_2O).
91.76 grams potassium sulphide (liver of sulphur, hepar sulphur).
1 gallon of water.

Chemical notes.—This mixture is in the form of an inky black fluid, which, on exposure, deposits an orange-yellow precipitate. When the proportion of potassium sulphide to ferrous sulphide is as low as three to one there is formed a precipitate in the liquid which gradually sinks to the bottom. Baric chloride gives the reaction for sulphuric acid in the solution. It is probably a compound of complex composition, as it is not described by Watts; possibly a potassium-iron sulphide (see Watts, 1872, p. 1077).

Remarks.—This mixture is more difficult to prepare than ammoniacal solution, covers the foliage no better, and adheres little if any better. It proved almost wholly ineffective in retarding the progress of the disease and was evidently slightly injurious to the foliage, although diluted to 2 gallons after the first application. The treated rows were 0 and ½ grades better than adjacent untreated rows on September 2, and 0 and 0 on October 13. Its fungicidal properties, if any, are slight.

No. 22.—ZINC BORATE MIXTURE.

(Rows 22 and 22[1].)

33.36 grams zinc sulphate ($ZnSO_4$, $7H_2O$).
33.36 grams sodium borate (borax) ($Na_2B_4O_7$, $10H_2O$).
1 gallon of water.

Chemical notes.—A remarkably gelatinous precipitate of a milky white color. The above proportions are necessary, as a variation either way from equal parts gives a precipitate which settles very rapidly. It is a compound of very vague composition (see Watts' Dictionary, 1888, p. 530). The reaction would be written $ZnSO_4$, $7H_2O + Na_2B_4O_7$, $10H_2O = ZnB_4O_7 + Na_2SO_4 + 17H_2O$. A zinc borate and a sodium sulphate are in combination in the spraying mixture.

Remarks.—This mixture is much more difficult of preparation than ammoniacal solution, covers the foliage less completely, and adheres with about the same tenacity. It proved markedly inferior in retarding the progress of the disease and injured the foliage slightly. The treated rows were 1 and ½ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13. A mixture with no qualities to recommend it for further trial.

No. 23.—ZINC FERROCYANIDE MIXTURE.

(Rows 23 and 23[1].)

33.36 grams zinc sulphate ($ZnSO_4$, $7H_2O$).
66.72 grams potassium ferrocyanide (yellow prussiate of potash).
1 gallon of water.

Chemical notes.—A yellowish white precipitate is formed by the reaction, settling very slowly. An increase of zinc sulphate causes a heavy precipitate to be formed, which sinks very rapidly. According to Watts' Dictionary, 1889, p. 337, the formula is Zn_2FeCy_6, $3H_2O$. The solution sprayed upon the plants contains in combination zinc ferrocyanide and potassium sulphate.

Remarks.—This mixture is much more difficult of preparation, covers the foliage no more effectively, and adheres with about the same tenacity as the ammoniacal solution. It proved wholly ineffective in retarding the progress of the disease and injured the foliage, necessitating a dilution to 2 gallons. The treated rows were 0 and 0 grades better than untreated adjacent rows on September 2, and 0 and 0 on October 13.

No. 24.—ZINC SILICATE MIXTURE.

(Rows 24 and 24[1].)

33.36 grams zinc sulphate ($ZnSO_4, 7H_2O$).
58.38 grams sodium silicate (water glass).
1 gallon of water.

Chemical notes.—An opalescent fluid with a precipitate which sinks very slowly. It is a compound of which little seems to be known. Watts does not include it. The chemical reaction would be written $ZnSO_4$, $7H_2O + Na_2SiO_4 = ZnSiO_4 + Na_2SO_4 + 7H_2O$. The mixture therefore contains zinc silicate and sodium sulphate in combination.

Remarks.—This mixture is more difficult of preparation, does not cover the foliage any better, and is less adherent than ammoniacal solution. It proved wholly without effect in retarding the progress of the disease and injured the foliage slightly. The treated rows were 0 and 0 grades better than adjacent untreated rows on September 2, and 0 and 0 on October 13.

No. 25.—ZINC SULPHIDE MIXTURE.

(Rows 25 and 25[1].)

33.36 grams zinc sulphate ($ZnSO_4, 7H_2O$).
66.60 grams potassium sulphide (liver of sulphur).
1 gallon of water.

Chemical notes.—A very fine greenish or yellowish white precipitate. Gives off odor of H_2S when potassium sulphide is added. The proportions were intended to be 1 to 2, but by a mistake 66.60 instead of 66.72, grams were used. Probably the compound is not clearly defined, as the liver of sulphur is a mixture of the trisulphides and pentasulphides, with intermediate forms, but without much doubt ZnS_5 is formed from the pentasulphide of potassium combining with the $ZnSO_4$.

Remarks.—This mixture is more difficult of preparation than ammoniacal solution and adheres to the foliage more tenaciously, but was slightly injurious and necessitated dilution to 2 gallons. It proved of scarcely any value in retarding the progress of the disease. The treated rows were 0 and 1½ grades better than adjacent untreated rows on September 2, and 0 and 0 better on October 13.

Summary.—While none of the above mixtures or solutions were really effective in preventing the leaf-blight, the retarding effect which several of them had upon the progress of the disease makes it seem probable that if their strength be increased they may prove valuable. The results of the year's experiments make possible the following classification, which will enable the investigator to choose for further experiment those mixtures worthy of trial:

(1) Mixtures which did not injure the foliage and retarded more or less the progress of the disease: Nos. 1. 2, 3, 5, 6, 9, 12, 13.

(2) Mixtures which injured the foliage, but retarded the progress of the disease: Nos. 4, 7, 8, 10, 11, 14, 15, 16, 17, 18, 22, 25.

(3) Mixtures which injured the foliage and did not retard the progress of the disease: Nos. 19, 20, 21, 23, 24.

As will be readily inferred, those mixtures under (3) are plainly excluded from further trial; those under (2) may possibly prove of value if sufficiently diluted, but since they only imperfectly retard the progress of the disease when strong, they are not likely to be effective when of sufficiently weak strength, while those under (1) are worthy of further trial in stronger proportions.

It should be remarked here, however, that these experiments were with pear seedlings only, and before making them applicable to other plants a trial will be necessary. This is plainly shown in the grape experiments with the same mixtures, in which many of the preparations that were not injurious to pear foliage proved injurious to the grape. The results of these experiments will appear elsewhere.

The writer is most forcibly impressed with the remarkable nature of Bordeaux mixture in this respect. Although the trials made by Smiths and Powell, of Syracuse, N. Y., with Bordeaux mixture upon seedlings were not satisfactory the present season, I am still of the opinion that had it been tried upon the experimental plat it would have shown itself superior to any of the other preparations employed. So far it seems to be the only preparation which gives to the foliage of treated plants an appearance of unusual health.

HORSE-CHESTNUT LEAF-BLIGHT.*

Horse-chestnut seedlings are subject to leaf-blight to such an extent that it has come to be looked upon by many nurserymen as something entirely normal to their growth—a natural ripening of the foliage. The disease first makes its appearance toward the latter part of June, and before the middle of August the leaves are generally entirely dead, often remaining attached to the seedlings until the middle of October or later. Although the damage done to the foliage of fully grown trees is not as serious in this northern climate as it is in the neighborhood of Washington, D. C., the young trees of two or three years' growth often have their foliage materially injured by the parasite. The principal growth of the horse chestnut being made very early, i. e., in the first six weeks, it is doubtful whether the loss to the plant is as great as in plants with a longer period of growth. The reserve material stored up must, however, be much less in defoliated stocks than in those maintaining healthy foliage throughout the season.

The experiments in the prevention of horse-chestnut leaf-blight were inaugurated in 1892, and only a preliminary report as to the effects of the fungicides is possible.

Two rows, comprising in all over one thousand seedlings, were under treatment. The seed was gathered from trees growing on the station grounds and planted in the fall of 1891 in shallow trenches. Nearly every seed germinated and an excellent "stand" was secured.

One row was divided into twenty-four sections, each containing twenty-five or more seedlings, and treated with the same mixtures as those described previously as being used on pear seedlings. Preparations Nos. 13, 14, 15, 17, 18, 19, 20, 21, 22, 23, 24, and 25 were used. Only alternate sections were treated, the intervening sections serving as controls. The dates of treatment were June 22, July 6 and 20, and August 1 and 15. At these dates the foliage of each section was thoroughly wetted with the preparation.

The disease first made its appearance the last week in June and spread very slowly over the experimental rows, injuring the foliage very irregularly. The sections, with two exceptions, seemed to be little benefited by the treatments. Preparations 14, 17, 18, 19, 21, 22, 24, and 25 injured the foliage to a greater or less degree. The injury manifested itself generally by a sickly yellow or brownish coloration of the foliage. On October 14 the only two preparations whose good effects were visible were Nos. 13 and 25. When every stock in these

* *Phyllosticta sphæropsoidea* E. & E.

sections was placed in one of four grades as regards injury to the foliage the record stood as follows:

Treatment.	Number of seedlings.	Number in grade 1.	Number in grade 2.	Number in grade 3.	Number in grade 4.	Average grade.
Mixture No. 13	31	9	17	4	1	1.9
Control on No. 13	25	2	12	3	8	2.6
Mixture No. 25	26	0	20	4	2	2.3
Control on No. 25	31	0	11	9	11	3.0

The beneficial effects of the treatments with mixture No. 13 were plainly evident, and of the twelve mixtures employed this is the only one promising good results. The second row was divided into six sections, sections 1 and 2 being treated five and six times, respectively, with ammoniacal solution, and sections 4 and 6 on the same dates with Bordeaux mixture. The dates of treatment and the formulæ for the mixtures are given on a previous page, and were the same as those for the budded stocks treated in 1892. Sections 3 and 6 were intended to serve as controls, but unfortunately, by mistake, section 6 received one treatment on June 16 with Bordeaux mixture. The beneficial effect of the Bordeaux mixture was evident, as the disease spread upon the untreated sections, but the ammoniacal solution was plainly injurious to the foliage, the leaves which were treated with this assuming a faded brownish hue. In October the difference between the untreated stocks and those sprayed with Bordeaux mixture was marked. The former had lost many of their leaves and had few perfect ones, while the latter were provided with almost perfect foliage. No marked difference between five and six treatments was observable. The preventive effect of ammoniacal solution, while apparent, was, in the sections treated five and six times, inferior to that of Bordeaux mixture.

On October 15 the earth was removed from the base, and the seedlings of sections 3, 4, and 5 were calipered at the collar. The following data were thus obtained:

	Average caliper in $\frac{1}{32}$ of an inch.
74 seedlings untreated	12.8
57 seedlings treated 5 times with Bordeaux mixture	12.6
75 seedlings treated 6 times with Bordeaux mixture	12.6

As is shown, no difference in diameter of treated and untreated seedlings was observable. It is hoped that another year's observations upon the stocks may be made to ascertain the effect of maintaining the foliage upon plants like the horse chestnut, which make their principal growth before the disease defoliates them. This preliminary experiment, however, certainly warrants the recommendation of Bordeaux mixture as a preventive of horse-chestnut leaf-blight.

PRUNE RUST.

By NEWTON B. PIERCE.

[Plates XXXIV-XXXVII.]

The prune, in common with many other drupaceous fruits, frequently has its leaves much injured or may be even entirely defoliated by a species of rust. This parasite belongs to the genus *Puccinia*, and is known as *Puccinia pruni* Pers. To Californians the effect of this disease on the prune, plum, and the peach is a very serious matter. The Pacific coast is known as the home of these fruits, and any widespread and detructive disease which affects them all should be well understood by horticulturists.

DISTRIBUTION AND ACTION ON THE STOCKS.

Prune rust is widely known, having almost as extended a distribution as the prune itself. It is found in the United States from the Atlantic to the Pacific, and the various countries of Europe are also quite generally infected. In the Eastern States it is most injurious to the plum and peach. In Texas the peach suffers severely from it, and in some sections is completely defoliated. In California the rust has a wide distribution. In the southern part of the State the injury is most serious in the coast valleys, where both the prune and peach are not unfrequently entirely stripped of their leaves before the wood is matured. Much fruit is lost both by the direct and the indirect action of the parasite. When the tree is defoliated before the fruit is mature the latter shrinks and becomes worthless; but the greatest loss generally occurs from the nonproductiveness of trees left with their wood immature in the fall.

As yet only two forms of spores are known for this species of *Puccinia*, the uredo or summer spore, and the teleuto or winter spore. These spores are produced in varying proportions on different plants. On some hosts the uredospores greatly predominate over the teleutospores, while on other hosts the reverse is true. It appears probable that conditions of food, humidity, climate, and season all tend to vary these results. Both spore forms are produced on the under side of the leaves, and probably both may, under some conditions, serve as winter spores.

The rust is known to affect the prune, plum, peach, nectarine, apricot, cherry, and almond. In California the prune sustains much greater injuries from rust during some seasons than others, depending largely on the early or late development of the disease. In 1891, at Santa Ana, the rust developed early in some orchards, and much fruit was either lost or materially injured by the premature fall of the leaves. In 1892, in the same orchards, the disease developed later and with much less virulence. Where severe enough to defoliate the trees the defoliation did not occur until the fruit had been gathered and most of the wood

was properly ripened. Both the general and special effects of the disease vary according to the situation of the orchard, the age and variety of stock, the soil, etc.

When it attacks the prune the parasite causes the upper surface of the leaf to turn a yellowish or reddish color in irregular blotches, of greater or less extent, according as the points of attack are separate or confluent. The spores make their appearance in brownish or blackish patches on the under surface of the leaf, the brown patches usually being made up of uredospores and the black of teleutospores. The uredospores often appear earlier in the season than the teleutospores, the latter being normally developed as winter spores. Both kinds of spores are of good size and well formed. When the rust is abundant the tissue of the lower portion of the leaf is destroyed in such a manner as to present continuous, brown, lifeless areas. With the Tragedy prune, grown on the place of Mr. D. Edson Smith, of Santa Ana, the tissue of the under surface of the leaves was entirely destroyed, and was covered by an almost continuous and very dense layer of spores.

The action of the rust on the plum is similar to its action on the prune. In Texas it is stated that wild plums are attacked. Both uredospores and teleutospores are found, the latter often predominating.

Peach trees are frequently badly affected by this rust, and the trees of an entire orchard are sometimes defoliated. On the upper surface of the leaves the infected parts become yellowish or reddish in irregular and somewhat angular blotches, and on their under surface in separate or confluent, yellowish or brown, somewhat circular spots. The spores are mostly uredospores, although the teleutospores are often found, at least in California.* The fungus lives over winter on the tender twigs of the peach, frequently almost killing the young nursery stock. For this reason it would be well to spray the trees during the dormant season as well as after the growth has begun. For this winter treatment the following mixture is recommended: 5 pounds of copper sulphate, 10 pounds of lime, and 45 gallons of water.

The extra amount of lime causes the fungicide to adhere better than the usual amount of 5 pounds in ordinary Bordeaux mixture. It is not positively known if the same holds good with the prune and plum, although it is probable. Where rust is very bad upon either of these fruits the winter treatment is recommended.

On the nectarine the rust produces both uredospores and teleutospores, but, as with the peach, the uredospores greatly predominate.

*In the Annual Report of the Commissioner of Agriculture for 1887, pp. 353–354, it is said that no teleutospores are developed on the peach. Although less abundant than the uredo form, they have invariably been found on badly infected peach leaves in southern California, and these leaves have been obtained from widely separated points in Los Angeles and Orange Counties, as at Florence, Santa Ana, Arch Beach, etc. They were fully matured by the middle of October.

The teleutospores are sometimes found in a semi-rudimentary condition. The spots are found on both surfaces of the leaf. The effects on the nectarine are similar to those on the peach.

In southern California the apricot is not commonly affected by rust to as great an extent as are the prune and peach, although usually the disease may be seen in nearly all orchards in the coast region. Sometimes the margin of the leaf is most affected, but all portions may be diseased. As in the previously mentioned cases, the uredospores predominate. The teleutospores are less abundant than upon the peach. The two forms when present are large and well developed. The rust produces on the apricot small, irregular, reddish, scar-like spots, which show on both surfaces of the leaf. The under surface finally turns a yellowish color and becomes powdery with the abundant uredospores. When badly diseased, the whole leaf may turn yellow and fall prematurely. As yet, however, I have not seen this tree entirely defoliated by the disease.

In the East the cherry is more or less injured by the same parasite, and I have no doubt that this is also the case for portions of the Pacific coast. As the cherry is neither extensively nor successfully grown in the warmer valleys of southern California, we have not had sufficient material for a general study. Farther north, and in the more elevated regions of the southern portion, where this fruit thrives, the parasite may be looked for.

The almond is infected by the rust to a limited degree. Both teleutospores and uredospores have been found, although the former were rare in the material examined. The teleutospores were rather small. The uredospores varied greatly in size and form, and in thickness of their walls. Some were dark and nearly spherical, while others were normal in form and thickness. So far as seen, the almond is not defoliated in California by the parasite.

TREATMENT.

The prune rust fungus is a truly endophytic parasite, vegetating and obtaining its nourishment wholly within the tissues of its host, and only appearing at the surface of the leaf for spore formation. This makes it evident that the treatment for the disease should be preventive in its nature. The application of sprays or other treatment after the parasite is within the tissues of its host can not act remedially and can only serve to prevent further infection.

The serious action of this parasite during the summer of 1891, and the fact that its attacks were more general and severe than in 1889, seemed to indicate that the disease was increasing, and it was decided to undertake a series of preventive experiments. This was the more necessary because the climatic conditions are very different in the coast valleys of southern California from those of the portions of the Eastern States

where most experimental work of this nature has been conducted. Methods applicable to the one region might be unsatisfactory in the other. It was desirable, also, that the work be done with the prune, which is not grown much in the East, and with which no experiments, as far as known, had been conducted. The line of treatment offering the greatest prospects of success was published by the writer early in the spring of 1892, so that those who desired might experiment in their own orchards.*

Portions of two prune orchards, in which the rust had developed to a marked extent in 1891 were selected for the experiment. The orchards were about 5 miles apart, one south of Santa Ana and the other east of Orange, Cal. The trees in one orchard were sprayed with modified eau céleste, while a portion of those in the other orchard were sprayed with modified eau céleste and a portion with ammoniacal copper carbonate. The number of treatments and time of application were varied with different lots of trees. Besides these, two other orchards in the vicinity of Santa Ana were sprayed by their owners, both gentlemen using the modified eau céleste according to the formula followed in our work. One of the orchards, belonging to Mr. Charles Leslie, is situated northwest of Santa Ana, on ground somewhat lower than that of any of the other orchards treated.

Fortunately for the growers, but unfortunately for our experiments, the rust did not develop as early, and was not as general nor as virulent in the season of 1892 as in 1891. The disease did develop, however, in the orchard of Mr. Leslie, though later than usual and with less virulence. Here a striking contrast was observed between the treated and untreated trees about the 1st of October, and we are now able to show the efficacy of the spray used and to give the details and necessary expense of application.

In relation to the application of sprays, it may be said that for young trees of small size and pruned low, the knapsack sprayer may sometimes be used to advantage. This is especially true of gardens and orchards of small extent. Treatment of small trees with a knapsack sprayer will require from one and one-half to three minutes per tree, according to size and state of development of the foilage. The tank of the sprayer holds about 4 gallons, and to avoid loss of time some convenient mode of refilling should be near at hand in the field. For trees 4 or 5 years old a cart sprayer holding one or two barrels of the spraying mixture is very convenient. Experiments were conducted with the "Little Giant" cart, holding slightly over a barrel. The tank is

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* See notes on "Fungous diseases and their treatment."<Proc. and Trans. of the Pomological Soc. of Southern California, Redlands, May 27 and 28, 1892, pp. 24–29; also, Rural Californian, June, 1892, pp. 303-305, and extracts in numerous other journals. The present season's work has shown that the disease may be controlled with fewer sprayings and at less expense than were thought necessary at the time these recommendations were made.

mounted on two large iron wheels, with a third and smaller wheel in front as a support. It is supplied with a good brass force pump capable of throwing two sprays. It may be drawn either by hand or by a horse directly attached, or it may be placed in a light one-horse wagon. The last arrangement raises the head of liquid, and enables the cart to be easily drawn in soft or plowed ground. A fair-sized orchard can be thus treated with little loss of time.

If the trees to be sprayed are large (5 years old or older), and especially if the orchard be extensive, it is well to have a special tank. The horizontal wooden tank, resembling a cylinder, but narrowed toward one end, is now considered by many the best pattern made, although somewhat more expensive than the rectangular box tanks. It is, however, much less liable to leak, and is especially suited to keeping its contents well stirred.*

From the fact that the rust fruits mostly on the under surface of the leaves, as well as from a study of the habits of other fungi in this region,† it appears probable that infection of the host occurs in most

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*For those who may desire to construct a tank of this description, measurements are given of the one owned and used by Mr. Leslie in his treated orchard. It is intended to rest on a platform placed upon the bolsters of a common lumber wagon, and supported and kept from rolling by transverse scantling made concave above. The length of the side of the tank is 9 feet 8 inches. Its diameter at the small head is 27 inches inside measure, and 31 inches outside measure. At the large end the inside diameter at the head is 31 inches, and the outside measure 35 inches. This diameter allows the tank to fit well between bolster stakes, which are 3 feet apart. The heads of the tank set back 3 inches from the ends of the staves. The staves are made of 2-inch dressed plank about 4½ inches wide at the broad end and narrowed toward the small end to about 4 inches, and are all beveled on the edge. Six bands of iron are used as hoops, which are $\frac{3}{16}$ by 2 inches. One is placed opposite each head and the other four at equal distances between them. This tank holds, approximately, 300 gallons, and by placing it so that its upper surface is level the tank may be completely filled; thus arranged, the last of the fluid it contains will flow to the large end, where all may be pumped out by the force pump situated there. The tank is filled through an opening 12 by 16 inches, supplied with cover and screen, located at the center of the tank. Near the bottom of the large head is a bung for cleaning out. The force pump is firmly fastened to the top and near the large end of the tank, and the suction pipe reaches nearly to the bottom. The pump should be strong, double-acting, furnished with large air chamber to insure an even flow, and is usually of the piston pattern. Brass fittings or a brass pump are preferable to those of iron. Arrangements should be made for dividing the discharge pipe by the attachment to its ends of separate lengths of hose. The hose should be of good quality and each piece should be about 25 feet long. Thus equipped, two trees may be sprayed on each side of the wagon before it is moved. The free end of each hose should be attached to a brass pipe 6 or 7 feet long, and carrying the nozzle at its extremity. Iron pipe corrodes too easily with the copper sulphate mixtures, and, being heavier, the work done with it is not apt to be as satisfactory.

†See observations on the habits of *Cercospora circumscissa* Sacc. in this Journal (vol. VII, No. 2, p. 69). This parasite is shown to affect almond branches to a much greater extent upon the lower than upon the upper surface. The more favorable conditions of humidity below the branch, there assigned as the partial cause, would apply equally well in the present case.

instances from the germination of spores on the under side the leaf. For this reason it is essential that the under surface receive the most thorough treatment. In the experiments here described four nozzles were used, viz, the Climax, the San José, the Cyclone, and the Improved Vermorel, and their adaptation to the work noted. They are all good nozzles, but when used with eau céleste mixtures a serious defect is found in all of them. The corrosive action of this spray, whether the latter be formed according to the modified formula or not, destroys the brass netting of the Climax nozzle and the brass plate containing the slot of the San José. The action on the other nozzles is similar, but the brass being thicker the openings enlarge less rapidly. The manufacturers of the Climax nozzles state their intention to supply aluminium nets for them, which will probably withstand the spray. This is a more important matter than it at first appears, and is especially so to Californians. In California fewer applications of fungicides are required than in the East, because of the partial absence of summer rains along the southern Pacific coast, but these applications should be more thorough. To properly spray a tree with one or two applications the spray must be fine, uniform, and carefully applied. To form this spray the nozzles used must be in good condition, which is not true when the openings are enlarged; in this case the liquid falls on the foliage in coarse drops, which run together and dry. When large areas are thus wetted the fluid will often "creep" or "crawl" when drying, as paints do when water is accidentally mixed with the oil. In this way the copper salts are brought together and dried in a few large areas instead of being distributed over the leaf in small drops which dry where they fall. With enlarged openings in the nozzle much of the leaf is therefore left without the protection of the fungicide, while with the fine spray the numerous collections of dried copper are distributed by the humidity of the atmosphere or dews and fogs to all parts of the leaf surface. To those who have applied the resin washes to citrous trees it will be apparent that the mode of applying sprays for fungi is quite different from that followed for scale insects. For the latter an effort is often made to uniformly coat the branches and foliage with the mixture, as the nature of the spray used will allow of this even when the parts are completely wetted. With the copper washes, however, the parts should be finely sprayed and not overwetted if the attacks of fungi are to be prevented in the most satisfactory manner. Foliage thus overwetted by almost any of the copper sprays, and especially by eau céleste, is apt to be more or less burned. Prune trees have been entirely defoliated where the spray was too coarse.

If the San José or Climax nozzle be used, the perforated plates and brass-wire screens should be replaced as soon as corroded. With the Cyclone nozzle no arrangement is found for a renewal of the corroded parts. Hence this nozzle, to be satisfactory, should be made of noncorrosive metal. It presents one very desirable feature, viz., the spray is

thrown out laterally. Where the spray is thrown directly ahead from the workman, especially if small trees are being treated, or if there be a wind, much of the spray passes beyond the tree. Besides this, the under surface of the foliage is not so perfectly sprayed as it could be by the use of a nozzle throwing a lateral spray upward toward the under surface of the leaves, or downward upon their upper surface. The application is thus made directly to the leaf surface to be treated and little loss of material or time is sustained. With those having a large number of trees to spray, this saving is of prime importance. There should always be a swivel in the pipe to which the nozzle is attached. This allows the easy turning of the pipe while spraying the interior of the top of the tree, and the spray is sent in all directions without withdrawing the pipe. Where it is not absolutely necessary to use eau céleste, corrosion of the nozzles will bé avoided by the use of ammoniacal copper carbonate. This spray, besides being nearly or quite as effective as the modified eau céleste and lacking the corrosive action on nozzles and other metallic fittings, has the advantage of not showing to an obvious extent upon the treated fruit. The eau céleste is often discernible upon the prunes at the time they are gathered.

The following are the formulæ for making ammoniacal copper carbonate and modified eau céleste:

Ammoniacal copper carbonate.—In a wooden pail place 5 ounces of copper carbonate, soften the carbonate to a paste by the addition of a little water, add 3 pints of strong ammonia (26), and stir until the carbonate is dissolved. If it will not wholly dissolve add sufficient ammonia to accomplish that result. Pour into a barrel holding 45 or 50 gallons and fill the barrel with water.

Modified eau céleste.—Dissolve 4 pounds of copper sulphate in a wooden vessel containing 10 or 12 gallons of water, and afterwards stir in 5 pounds of sal soda. When the soda is dissolved pour in 3 pints of strong ammonia (26°) and dilute to 45 gallons with water.

As already indicated, the Leslie orchard, which was sprayed with modified eau céleste, presented the most evident beneficial results seen in any of the orchards treated. This, it is believed, was not due to any superiority of eau céleste over ammoniacal copper carbonate, but to the early and more marked development of the disease in that orchard than in the others. It has been shown during the past summer, in a carefully conducted series of experiments in combating the shot-hole fungus of the almond (*Cercospora circumscissa*), that modified eau céleste and ammoniacal copper carbonate possess almost exactly equivalent value as fungicides. This being true, there are several reasons why the amoniacal copper carbonate is to be preferred for this work: (1) It costs much less than the other spray; (2) it is less liable to injure the foliage, and does not seriously affect the nozzles and other metal appliances used in spraying; (3) spotting of the fruit and foliage is much less distinct than that caused by modified eau céleste; (4) it is easier to prepare.

The cost of the ammoniacal copper carbonate will vary in different portions of the country. The wholesale price of copper carbonate in the Eastern cities is about 40 cents per pound. To this about 3 cents should be added for freight to the Pacific coast, making the cost 43 cents per pound in California. Ammonia (26°) can be had at 8 cents per pound in the East, and should not exceed 10 cents per pound in California. At these prices the cost of the ammoniacal copper carbonate solution, made according to the above formula, would be $1 per 100 gallons. This cost may be reduced by making the copper carbonate at home from sulphate of copper and sal soda, as follows:

To make copper carbonate.—Dissolve in a large wooden tub 6 pounds of copper sulphate in hot water. In another wooden vessel dissolve 7 pounds of sal soda in hot water. When both solutions are cool pour the soda solution into the copper solution and fill the tub with water. Unite these mixtures slowly or they will overflow. Stir thoroughly after the water is added and allow the solution to stand twenty-four hours; then draw off all the clear liquid with a siphon. Fill the tub with water, stir, and again allow it to stand twenty-four hours and settle, and then draw off the liquid as before. Dry the substance remaining, which is mostly carbonate of copper. When dry it should be a light green powder. The sediment may be dried in an earthen jar kept in a kettle of boiling water or in the sun.

If the sulphate of copper and sal soda are of good quality, which may be told by the deep blue of the former and the transparency of the latter,* the quantity given in the above formula should make 2½ pounds of the carbonate.

The average wholesale price of copper sulphate in the East is 6 cents per pound and that of sal soda 1½ cents. The Santa Fe Railroad Company has quoted freight rates on these chemicals from Chicago to Santa Ana at 1½ cents. This makes the cost of copper sulphate on the Pacific coast 7½ cents and of sal soda 3 cents per pound. At these rates 6 pounds of copper sulphate and 7 pounds of sal soda would cost 66 cents; and as this quantity makes 2½ pounds of the carbonate, the cost per pound of this chemical, when made at home, is 26 cents. For 45 gallons of spray, according to the above formula, there would be used 5 ounces of carbonate, worth 8 cents, and 3 pints of ammonia, worth 30 cents, a cost of 80 cents for 100 gallons, or a saving of 20 cents per 100 gallons by the home manufacture of the carbonate. At the above prices for copper sulphate, sal soda, and ammonia, when used to make modified eau céleste, 45 gallons would cost 75 cents, or $1.66 per 100 gallons.

The amount saved by using the ammoniacal copper carbonate instead of the modified eau céleste is worth considering where a large orchard is to be sprayed. With the other advantages already enumerated, the

*Air-slaked sal soda or pale blue sulphate of copper should never be used in any spray work. If the former be used in making copper carbonate, a magma will be formed when the two mixtures are united, which will prevent the satisfactory completion of the process; and if it be used in making the modified eau céleste the acid of the spray will remain so strong as to burn the foliage.

former spray becomes much more desirable than the latter for most work..

The cost of spraying an orchard depends upon the size of the trees, the state of development of the foliage, the presence or absence of wind when the sprays are applied, the fineness of the spray used, the thoroughness of the work, and the cost of labor and material.

About 350 prune trees 5 years old were sprayed in the Leslie orchard with 600 gallons of modified eau céleste, the application of which required three men and a team for thirteen hours. In this work the San José nozzle was used. The corrosive action of the spray injured the plates of the nozzles so that more of the solution was used than was required to do the work. The direct throw of the spray added to this loss and the loss of time was proportionate. From carefully kept records of my own experimental work, it appears that at least 25 per cent more material and time was consumed in this orchard than was needed if the work had been done with ammoniacal copper carbonate applied with a lateral nozzle. This would reduce the spray needed to 450 gallons, and the time for applying to about ten hours. The cost of 450 gallons of ammoniacal copper carbonate at $1 per 100 gallons is $4.50. Estimating the cost of a man and team at $3 per day, and of 2 men for applying the spray at $1.50 each per day, the cost of applying the spray would be $6 for ten hours, or 60 cents per hour. At this rate the total cost is $10.50 for 350 trees, or an average of 3 cents per tree for a single spraying. This is not an underestimate, where the chemicals are purchased at wholesale prices and properly applied. The expense of spraying large trees will be increased in proportion to the increase in size.

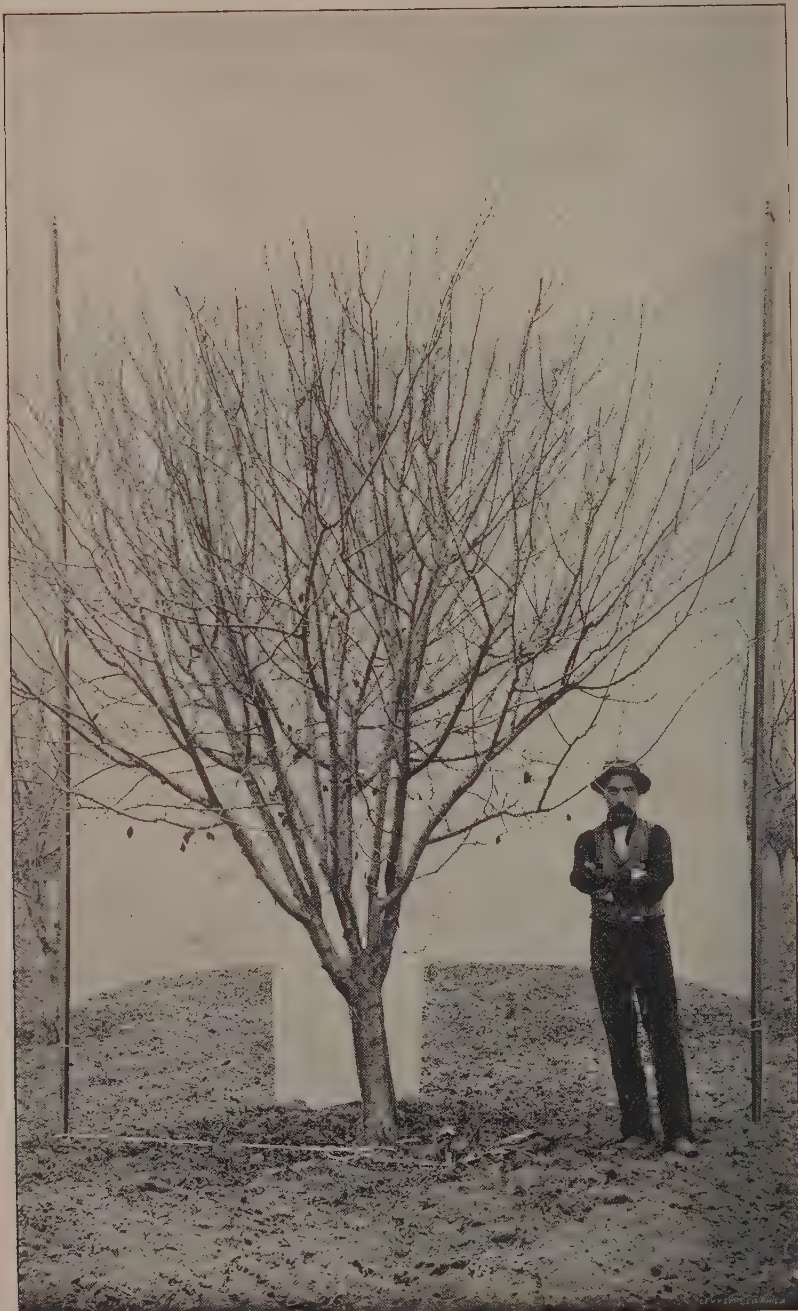
The number of treatments necessary to prevent the injurious effects of the parasite varies from season to season. In the East the treatments should be more numerous and at shorter intervals than in California. At present it is believed that in southern California two thorough sprayings of the prune tree will sufficiently keep the parasite under control. Although no rigid rule can be given as to dates, it is probable from the past season's work that the first treatment may be safely made about the time the trees cease to bloom, and when the old wood is in nearly full leaf. A second spraying should be made after a fair amount of new wood and foliage has been formed. When these two treatments are carefully and thoroughly made, say about the 1st of May and again about the 1st of June, varying according to conditions, it will rarely be found necessary to treat the trees a third time, unless the orchard be situated in a low and damp region. In this case a third spraying may be given two to three weeks after the second.

The dry summers of California allow the spray to remain on the foliage until the fall rains, that is, in cases where the applications are made after the last spring rains. In the Santa Ana Valley trees sprayed in May clearly showed the copper on their leaves as late as the last of October.

PRUNE ORCHARD TREATED FOR RUST.

Prune Orchard Untreated and Defoliated by Rust Fungus.

TREATED PRUNE TREE 5 YEARS OLD.



Untreated Prune Tree 7 Years Old.

DESCRIPTION OF PLATES.

PLATE XXXIV.—Leslie prune orchard, 7 years old, grown on a rich, deep, fine sedimentary soil; situated about 2 miles northwest of Santa Ana, Cal.; affected by rust in 1891 and again in 1892. It was sprayed with modified eau céleste during the first half of June, 1892, receiving one treatment during the season. This treatment was sufficient to cause the trees to retain their foliage, to the extent shown, until October 4, when the photograph was taken. Compare with Plate XXXV, which shows the untreated half of the same orchard.

PLATE XXXV.—Unsprayed half of the prune orchard represented in Plate XXXIV. The trees were defoliated through the action of rust. Photographed October 3.

PLATE XXXVI.—Prune tree 5 years old, treated about the 1st of June, 1892, with modified eau céleste. This tree was in an orchard affected by the rust, and should be compared with the tree shown in Plate XXXVII. Photographed October 3, 1892.

PLATE XXXVII.—Prune tree 7 years old and wholly defoliated by rust. Had been bare some time before the photograph was taken on October 3, 1892. Compare with Plates XXXIV and XXXVI.

PRELIMINARY NOTICE OF A FUNGOUS PARASITE ON ALEYRODES CITRI R. & H.

By H. J. WEBBER.

In the course of some investigations on "sooty mold,"* a fungous disease of the orange and other citrous fruits, it was soon learned that in order to successfully combat the fungus means must first be found to remove the insect pests, which evidently induce the disease. In Florida the "sooty mold" is principally nourished by the honeydew excreted by *Aleyrodes citri* (the so-called "white fly") and certain waxy scale insects and aphids; however, it becomes serious only as it follows *Aleyrodes citri*. In view of these facts, experiments have been conducted for the purpose of determining the most effective means of combating *Aleyrodes*. Attempts have been made to discover insect enemies of *Aleyrodes citri* which would aid in keeping the pest in check, but to my knowledge no such parasite has been discovered. In this state of our knowledge, I am fortunately able to announce the discovery of a fungus which is parasitic on the larvæ and pupæ of *Aleyrodes citri*, and which may prove useful in fighting the insect.

While walking through the orange grove of Mr. J. H. T[illegible]rp, of Crescent City, Fla., in August, 1893, some leaves infested with the larvæ and pupæ of *Aleyrodes citri* were collected. Mixed with the insects on the same leaves the orange-red pustules of a fungus were found, but nothing was thought of the significance of the discovery at the time. In January, 1894, I visited the orange grove of Mr. W. B. Varn, at Bartow, Fla., and again found the same fungus in considerable abundance. A more careful examination of this material led to the conclusion that the fungus was probably a parasite on the larvæ and pupæ of *Aleyrodes*

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* *Capnodium citri* B. & Desm.

citri. Numerous groves where the fungus infests *Aleyrodes* have since been examined, particularly in the vicinity of Crescent City and Gainesville, Fla. The fungus has been provisionally identified as *Aschersonia tahitensis* Mont. It occurs in orange groves at Crescent City, Bartow, Panasoffkee, Gainesville, and Manatee. In the noted groves of Citra, Fla., where some 300 acres of orange grove are literally black from the effects of "sooty mold" following *Aleyrodes*, no signs of *Aschersonia* have as yet been discovered. Many other groves in the State where *Aleyrodes citri* occurs still remain free from this friendly fungus.

Experiments have been started to spread *Aschersonia tahitensis* into uninfected groves, both by introducing small trees harboring affected *Aleyrodes citri* pupæ and also by artificial means.

In the town of Gainesville, where for a number of years *Aleyrodes citri* has been very abundant and destructive, the trees are now acknowledged by general accord to be much better than they have been since first attacked. An examination of the trees here shows *Aschersonia* to be very abundant. On many trees it is indeed difficult to find a living pupa of *Aleyrodes citri*. In such cases the lower surfaces of the leaves are thickly dotted with the orange-red pustules of *Aschersonia*.

When the parasitic fungus (*Aschersonia tahitensis*) has grown to maturity it is easily removed from the leaf, the switching of the leaves and branches resulting in the removal of many of the pustules. The bright green spots, where the surface of the leaf is thus revealed, surrounded by the black "sooty mold," are quite conspicuous.

The growth of *Aschersonia tahitensis* on the larvæ and pupæ of *Aleyrodes* causes the scale to noticeably enlarge. The hyphæ of *Aschersonia* burst out around the edge of the scale, forming a dense fringe. The mycelium gradually grows up over the scale and eventually entirely surrounds it, so that in the advanced stages of the fungus it is difficult to find the fragments of the *Aleyrodes* scale.

A species of *Aschersonia*, probably the same as that infesting *Aleyrodes citri*, has also been discovered at Gainesville, Fla., growing in considerable abundance on a waxy scale (*Lecanium*) of the sweet bay tree. This scale also secretes honeydew in considerable quantities and is followed by the "sooty mold."

In the present stage of the investigation it can not be positively stated whether the spread of *Aschersonia* will be rapid enough to materially check the ravages of *Aleyrodes citri*, but appearances point strongly to this conclusion. The matter is being investigated and will be reported upon later.

SUBTROPICAL LABORATORY,
Eustis, Fla.

AN IMPROVED METHOD OF MAKING BORDEAUX MIXTURE.

By W. T. Swingle.

Since the first of the year I have had under way rather extensive experiments with Bordeaux mixture to determine its effectiveness in preventing a fungous disease of the lemon known as scab. The necessity of making large quantities of the mixture soon showed how slow and inefficient the common methods for its preparation are. After a number of attempts a much quicker and at the same time better method was worked out, and it is the object of this paper to call attention to the method. It might be noted that the lemon proves to be exceedingly sensitive to slight changes in the composition of the mixture, and hence is a very good plant to use in determining the best form of this fungicide.

METHODS OF DISSOLVING THE COPPER SULPHATE.

Probably the best method of dissolving large quantities of copper sulphate without heat is that suggested by Mr. M. B. Waite in 1893 and described on page 336 of this number of the Journal. By this method it is a simple matter to prepare strong solutions containing as much as 2 pounds of copper sulphate to the gallon. Moreover, it is possible to use large crystals instead of the more expensive and more easily adulterated pulverized bluestone. Another method, still more expeditious and superior to the old way of pouring hot water on the bluestone and stirring it till it dissolves, is to conduct steam into the bottom of a barrel containing the copper sulphate and water. With a small supply of steam, especially if under considerable pressure, the water can be heated in an incredibly short time. Besides, the current of steam issuing from the pipe sets the water and crystals in violent motion and insures a frequent change of the water in contact with crystals. In all cases where the solution is effected with the aid of heat it should be allowed to cool before being used.*

STOCK SOLUTION OF COPPER SULPHATE.

As early as 1887 the French viticulturist Ricaud† published an account of a method of making a strong solution containing a known weight of copper sulphate to each liter. This makes what is commonly

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* While working at the Kansas Experiment Station in 1890, Prof. W. A. Kellerman and myself found steam conducted through a small pipe fitted with a stopcock to be a most valuable means of keeping the temperature of the water at 132° F. for treating smut of oats and wheat (see Kellerman and Swingle, Kans. Agr. Exp. Sta. Bull. No. 12, Aug., 1890, p. 49; and Georgeson, Burtis, and Shelton, Kans. Agr. Exp. Sta. Bull. No. 29, Dec. 29, pp. 177–178). Mr. W. C. Hewitt, manager of the Sunset Orange Company, Stanton, Fla., tells me that he finds steam invaluable in making sodium sulphide, kerosene emulsion, and other sprays. This method of heating is unquestionably the best for all who have steam available, and should be generally used by such.

† Ricaud, J. Le traitement du mildiou, la dissolution cuivreuse comparée aux autres préparations liquides (Jour. d'Agr. Prat., 51e ann., t. 1, No. 3, Jan. 20, 1887, p. 90).

known as a stock solution. In this country Mr. Waite has used this system with great success. His method is described on page 337 of this number of the Journal. The advantages of the system are obvious; the delay occasioned by having to dissolve small amounts at a time is avoided, since a large amount can be dissolved in advance and any required number of pounds can be quickly obtained by measuring out the proper number of gallons without any operation of weighing. If steam is used for dissolving the copper sulphate, exactly the same method may be adopted as when the substance is dissolved by suspension. When it is desired to have the solution ready for use in a few hours, and neither steam nor hot water is at hand, a stock solution containing only 1 pound to the gallon can readily be made.* In no case should the copper sulphate be dissolved or stored in an iron kettle or other metal receptacle, since the copper is thrown down and other sulphates formed. A case recently came to my notice where after prolonged boiling of the copper sulphate solution in an iron kettle, the copper was all thrown down in the form of metallic scales, and the liquid on testing proved to be almost pure iron sulphate in solution. The solution can be kept a few days or a few weeks in a wooden vessel without noticeable change, but probably can not be left indefinitely without a slight loss† of strength. The vessel should of course be kept covered to prevent evaporation and to keep out impurities.

SELECTING AND SLAKING THE LIME.

Only the best well-burnt fresh stone lime should be used in making Bordeaux mixture. All powder occurring in the barrel should be looked upon with suspicion, since it is very likely to be air-slaked and consequently worthless and even dangerous to use for this purpose. In slaking, some little care is required in order to get uniformly good results. If 50 or 100 pounds are to be slaked, the amount can be placed in a barrel or other water-tight vessel. A considerable supply of water should be at hand, so that the lime will not get too dry from taking up water faster than it can be supplied. At first water should be added slowly, stirring vigorously; it should be added just as fast as it is taken up by the lime. The lumps of lime should never be allowed to project into the air for more than a few seconds. The whole slaking mass must be most thoroughly stirred or the lower portions will not be wetted at all, the upper layers absorbing all the water. It will not do to have just enough water to cause the lumps to swell and fall to a

* In this case instead of weighing out twice as many pounds as the barrel holds gallons, the same number of pounds are weighed out and suspended for solution. When all dissolved, the liquid is brought up to the required amount. This gives a solution containing 1 pound to the gallon.

† According to Clément, as quoted by Biedermann in Ladenburg, Handwörterb. d. Chemie, 6, 305, a solution of copper sulphate kept in a wooden vessel gradually deposits crystalline copper.

powder, since in this case the product is lumpy and makes a mixture of poor quality that clogs the nozzle badly. The milk of lime obtained should be of the consistency and have much the appearance of thick cream, and should be free from granules when felt between the fingers. In slaking a small amount of lime, such as 1 or 2 pounds, the mistake may easily be made of adding too much water and thus greatly retarding the action. In such cases it is best to use hot water, adding it little by little as it is absorbed. There is very seldom any difficulty in getting large amounts of lime to slake.

STOCK MILK OF LIME.

It has been found that the stock method, so valuable with copper sulphate, can be used with equal advantage for the lime. A barrel is taken, the capacity of which has previously been carefully determined, and twice as many pounds of stone lime are placed in it as it holds gallons. The lime is then slaked. If the slaking has been properly done the milk of lime will fill two-thirds to three-fourths of the space; then water is added to bring the milk of lime up to the mark. After stirring thoroughly a gallon will contain the equivalent of 2 pounds of fresh lime.* It is essential that the milk of lime be well stirred, preferably with a broad paddle. If the clear limewater be taken it will contain only about $\frac{1}{6}$ ounce of lime instead of 2 pounds. However, as the slaked lime is only a trifle more than twice as heavy as the liquid and is in an extremely fine state of subdivision, it is found easy in practice to stir up the milk of lime in a few moments, so that it is of practically uniform composition throughout. The stirring must be repeated each time a quantity is dipped out. In settling, the lime leaves a clear layer of limewater above. This contains about 1 part in 800 of slaked lime in solution and absorbs carbonic acid readily from the air, forming a pellicle over the surface. The barrels of stock lime should be kept as closely covered as possible, though if not jarred the loss from this source is certainly very small in the course of a few days or weeks. However, it is best to slake all the lime as soon as received, and in case the barrels of stock lime have to stand more than a fortnight before being used, the barrel should be headed up tightly and either the head kept covered with water or the whole buried in the ground, as suggested by Mr. Waite.

PROPER RATIO OF LIME TO COPPER SULPHATE AND MEANS OF TESTING THE MIXTURE.

The almost universal practice in this country has been to use 4 pounds of lime to 6 pounds of copper sulphate. There has been advocated of

* In case the stock milk of lime is to be used at once, it will be necessary to allow it to cool, since the heat liberated during the slaking makes it very hot, and Bordeaux mixture made hot is different in composition, settles rather quicker, and is doubtless decidedly inferior to the mixture prepared at ordinary temperatures.

late, however, the method of Patrigeon,* i. e., adding the milk of lime gradually to the copper sulphate until the mixture no longer gives a brown precipitate with a solution of the yellow prussiate of potash (potassium ferrocyanide). In his bulletin on Bordeaux mixture, soon to be issued by this Division, Mr. D. G. Fairchild expresses doubt as to the value of this method. As usually recommended, it is certainly not by any means an easy method to apply, though it is often assumed to be so. If, as is usually the case, there is no means of knowing exactly how much lime is added, it is a tedious process to obtain enough without running the risk of using a great excess. As long as the amount of lime added is too small the mixture will give on adding a drop of potassium ferrocyanide solution a brown reaction plain enough to be seen against the greenish blue precipitates, but when nearly all the copper sulphate has been neutralized by the lime it is impossible to obtain the reaction without waiting for the mixture to settle and then testing the clear liquid. Well-made Bordeaux mixture settles very slowly and begins to deteriorate as it settles. Moreover, I am convinced that the mixture is not of as good quality when the lime is poured in little by little as when the proper amount is added all at once. By using the stock milk of lime described above, a definite idea is obtained of the amount of lime that has been added. Moreover, the proper ratio, when once carefully determined, can be followed without further testing in using up the rest of the two stock solutions tested. Lime must be added as long as a brown color is apparent, when a few drops of the solution is added to the mixture. A convenient way of making the test is to place a column of the mixture several inches deep in a small vial and add a few drops of the solution of potassium ferrocyanide.

Unless care be taken to add the milk of lime gradually, there is no assurance that there is not a large excess of lime in the Bordeaux mixture as prepared by Patrigeon's method. However, if the clear liquid obtained by letting the mixture settle be tested with a little copper sulphate solution, an excess of lime will be shown by a bluish precipitate being formed. If it forms instantly and is very dense, there is a large excess of lime, but if it forms only after standing a few minutes and is very faint and whitish, there is only a slight excess. If in a few moments the clear liquid turns red litmus paper blue, there is an excess of lime; if blue litmus paper turns red, there is an excess of copper sulphate present. A simple method of testing for copper sulphate (one nearly as sensitive as the potassium ferrocyanide and which can be applied without waiting for the liquid to settle) is to immerse the polished blade of a steel knife in the solution and notice if after a minute or two it becomes coated with copper. If it does become so coated

*Patrigeon, G. Revue Viticole. <Journ. d'Agr. Prat., 54e ann., t. I., No. 20, May 15, 1890, pp. 700-704.

there is still copper in solution in the fluid. However, one of the best tests for the mixture is simply to notice the color. If too little lime is added it turns a greenish blue, if a slight excess is used the color is a beautiful sky-blue, and this is the color the mixture should show. If a great excess of lime is added the mixture takes on a slightly purplish shade of color, especially after standing a few hours. Probably the best test for the presence of an excess of lime, even when slight, is to pour some of the mixture into a broad, shallow vessel (a saucer for instance), and after a moment or two there will be formed a delicate pellicle over the whole surface. This pellicle can readily be seen if the dish is held to the light properly. It breaks when stretched and wrinkles when compressed. The amount of lime added is also a guide in the proper making of the mixture. Theoretically, $1\frac{1}{3}$ pounds of lime are required to neutralize 6 pounds of blue sulphate of copper. With ordinary lime, however, this amount is insufficient. Usually it takes twice as much to throw down all copper in solution, viz, $2\frac{2}{3}$ pounds. In general with good lime it is recommended that 3 pounds be used for every 6 pounds of sulphate of copper. This strength has been found very good for the lemon, which is injured by an excess of copper sulphate and also by any considerable excess of lime. It should never take more than 4 pounds of lime to neutralize 6 pounds of copper sulphate (unless a white or anhydrous copper sulphate has been used).

To sum up, properly made Bordeaux mixture should show a beautiful sky-blue color, and should form a faint membrane on the surface when exposed to the air for a moment in a broad dish. The clear liquid obtained on settling should give no brown color with yellow prussiate of potash solution, and should give a slightly bluish precipitate with copper sulphate solution. To obtain this result about 3 pounds of stone lime for every 6 pounds of copper sulphate should be used. Made in this way, the mixture is free from any copper in solution and also free from the greenish blue basic compounds, whose action on the plant is still in doubt. It contains a slight excess of lime very possibly beneficial to some plants, and certainly less injurious in slight excess than would be copper sulphate.

SHOULD THE MIXTURE BE MADE UP AS NEEDED OR MADE UP MORE CONCENTRATED AND DILUTED AFTERWARDS?

In using stock solutions of copper sulphate and lime, one or both may be diluted before they are mixed. I am convinced that it is of great advantage to dilute both solutions. In the mixture made from dilute solutions the chemical changes necessary to the formation are more quickly accomplished, and, best of all, the precipitates formed settle much more slowly. Ordinarily I would recommend diluting each constituent to one-half the amount the mixture is to make when completed. Then the two dilute solutions, after having been thoroughly stirred,

are poured together in the spray tank or barrel and again thoroughly stirred.* In making the mixture from diluted solutions it is best to have two vessels, each holding half as much as the tank; the proper amount of copper sulphate and lime stock can be measured out and each diluted without the trouble of measuring the water added. The superior quality of Bordeaux mixture made in this way will fully repay any extra labor of making. It does not suffice to dilute only one of the constituents.

KEEPING QUALITIES OF BORDEAUX MIXTURE.

The sooner the Bordeaux mixture is used after being made, the better. Changes in the precipitate soon begin; it eventually becomes coarsely granular, settles very quickly, and adheres very poorly to the foliage. Probably no serious degeneration of the mixture takes place inside of three or four hours, but there can be little doubt that it is decidedly of inferior quality after standing twenty-four hours.

ADDITION OF SOAP TO BORDEAUX MIXTURE.

As has been found by Galloway† and Fairchild, the addition of soap to the mixture greatly increases its wetting properties, and makes it much better for spraying plants having a waxy cuticle, and hence difficult to wet thoroughly. The exact nature of the chemical changes produced by adding soap is as yet almost unknown. The practice has been to add soap in solution until an abundant and permanent foam is produced upon stirring the mixture violently. Usually a considerable quantity of soap is required to produce this effect, about half as much as the total weight of copper sulphate and lime used. The soap should be in solution; with hard soaps it is best to shave into thin slices, dissolve in hot water, and add to the finished mixture warm. Soft soaps may be diluted and added cold.‡

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* For instance, in making given stock solutions containing 2 pounds of copper sulphate or lime to the gallon, in making a mixture of the strength of 6 pounds of copper sulphate and 3 pounds of lime to 50 gallons, the procedure would be as follows: Take 3 gallons of the stock copper sulphate solution and dilute with 22 gallons of water, making 25 gallons in all; after stirring well it is ready for use. Take 1½ gallons of the stock milk of lime and dilute with 23½ gallons of water, making 25 gallons. A mark can readily be made showing to what point the barrels are filled and rendering it unnecessary to measure the water added after the first time. After stirring both the diluted solutions well, pour them at once into a tank or barrel, straining through close-meshed wire netting. The mixture should now be thoroughly stirred with a broad paddle for at least two minutes.

†Galloway, B. T. Experiments in the treatment of rusts affecting wheat and other cereals. <Jour. of Mycol., vol. VII, No. 3, May 1893, pp. 195-226.

‡In this connection I would suggest that the very cheap resin soaps be given a thorough trial for this purpose. Take 2 parts of resin and 1 part of crystallized sal soda (sodium carbonate, Na_2CO_3, $10H_2O$), melt together in a kettle, stirring until all lumps disappear; then dilute with about 4 parts of hot water, which will make a stock solution containing 3 pounds of the soap to the gallon. This should be diluted

SUMMARY.

(1) Copper sulphate may be dissolved very easily by suspending the crystals in a loosely woven cloth or basket near the top of a vessel filled with water or by conducting steam into the vessel through a pipe.

(2) It is most convenient to make up a stock solution containing 2 pounds of copper sulphate to the gallon.

(3) Only the best freshly burned stone lime should be used in making Bordeaux mixture. When slaked it should be free from coarse granules.

(4) Stock milk of lime containing the equivalent of 2 pounds of unslaked lime to the gallon may be readily prepared.

(5) The method of testing Bordeaux mixture with a solution of potassium ferrocyanide to determine when enough lime has been added, is difficult to apply in practice unless stock milk of lime be used.

(6) The color of the mixture is a good indication of its composition. When properly made it is of a deep sky-blue color. Such a mixture contains a slight excess of lime, and on standing a few moments in a broad, open vessel is covered with a thin pellicle of calcium carbonate. The clear liquid left after settling gives no brown color with potassium ferrocyanide solution, but does give a slight precipitate of a light bluish color with copper sulphate solution.

(7) To obtain a mixture giving the reactions noted above, about 2½ to 3 pounds of lime will be needed for each 6 pounds of copper sulphate used.

(8) It is very much better to dilute both the copper sulphate solution and the milk of lime before mixing than to mix the strong solutions and dilute to the required quantity afterwards.

(9) The mixture begins to deteriorate within a few hours after being made and should therefore be applied as soon as possible. It should never be allowed to stand as long as twenty-four hours before using.

(10) The addition of soap to the finished mixture greatly increases its wetting properties and adds to its value for all plants with a waxy coating on the parts sprayed. The soap should be added in solution and in sufficient quantity to make the mixture foam well when stirred violently.

(11) The very cheap resin soaps are sufficiently promising to deserve a thorough trial for use with the Bordeaux mixture.

SUBTROPICAL LABORATORY,
Eustis, Fla.

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with about 2 parts of water when added to the Bordeaux mixture. This soap costs only about 1½ cents a pound in large amounts, while whale-oil soap costs about four times as much, and ordinary good hard soap costs five to twelve times as much. From a few preliminary trials made, it seems to be even better than ordinary soap to make a foam with Bordeaux. Albert Koebele found a similar resin soap to be a good insecticide for some haustorial insects (see Annual Reports of the Commissioner of Agriculture for 1886 p. 558; 1887, p. 146; and 1888, p. 130).

A NEW METHOD OF TREATING GRAIN BY THE JENSEN PROCESS FOR THE PREVENTION OF SMUT.

By B. T. Galloway.

During the past year Mr. Elam Bartholomew, of Rockport, Kans., a special agent of the Division, made some interesting experiments in the treatment of oat smut by the Jensen or hot-water process. Among other things, Mr. Bartholomew devised a method for treating large quantities of grain without resorting to the tedious basket-dipping process. The latter, he says, will answer fairly well for a few bushels of grain, but where a large acreage is to be planted the labor involved and the general inconvenience of the work will prevent many farmers from adopting the method. Mr. Bartholomew's method of treating 5 bushels of grain at a time was essentially as follows:

A common kerosene barrel was procured and after removing the head a 1½-inch hole was bored in the bottom close to the rim. The hole was then covered with a piece of wire window screen, the latter being tacked to the bottom of the barrel on the inside. A pine plug was then fitted to the hole from the outside in such a way that the end barely reached the fine wire screening. After making these preparations the barrel was placed on a box high enough to allow a pail or tub to be slipped under the bung. An old well bucket, such as are used in bored wells, was then obtained, and after removing the bottom, four rows of half-inch holes, running the entire length of the bucket, were punched. The holes were punched, as nearly as possible the same distance apart, six being placed in a row, making twenty-four in all. After punching the holes the bucket was placed in the center of the barrel, bottom end up, and resting on its bail, thereby raising it 4 or 5 inches from the bottom of the barrel and causing it to project a little above the top of the latter.

Holding the bucket in position, 5 bushels of badly smutted oats were emptied into the barrel. There were already on hand a common wash boiler and an iron pot filled with water which had been heated to boiling point on the cook stove. The contents of the two vessels were cooled to 130° F. by the addition of cold water, thereby increasing the quantity of liquid to 15 gallons. This was then poured into the bucket in the center of the barrel until all the grain was covered. The floating grain was pushed under with the hand and the barrel covered with a cloth to hold in the heat. After standing ten minutes the water was drawn off through the hole at the bottom of the barrel, the temperature in the meantime having fallen to 100° F. More boiling water was added to the water drawn off, until the temperature reached 133° F., when the liquid was again poured into the barrel and allowed to stand ten minutes, as before. Again the drawing off and heating process was repeated, the water being poured back into the barrel and allowed to

stand ten minutes. It was then drawn off for the last time and a new lot of grain put in and treated as in the first case.

Mr. Bartholomew says that seed treated in this way yielded less than one-tenth of 1 per cent of smutted oats, while in fields where no treatments were made 20 per cent of the grain is often affected with the fungus. A piece of 6-inch stovepipe, it is thought, will answer the same purpose as the bucket. The pipe should be arranged so that it will stand at least 4 inches above the bottom of the barrel.

FIELD NOTES, 1892.

By Erwin F. Smith.

[Plate XXXVIII.]

A NEW MELON DISEASE.

A widespread disease of muskmelon leaves was observed in southwestern Michigan in September. The foliage was destroyed almost completely over whole fields and the fruits failed to ripen. The symptoms suggested the work of a *Peronospora*, but an *Alternaria* or *Macrosporium*, supposed at first to be a saprophyte, was the only fungus found. Owing to the economic importance of this disease it will be made the subject of a special paper, the fungus having since been studied in the laboratory and the disease reproduced in the field by pure cultures made from single spores.

GRAPE POWDERY MILDEW.*

The powdery mildew of the grape was abundant on many varieties in an experimental vineyard at South Haven, Mich. The perithecia were well developed and numerous on September 19, although there had been no cold weather or frosts. This is opposed to Viala's hypothesis, that severe frosts are necessary for the formation of the perithecia.†

APPLE SCAB.‡

Apple scab was exceedingly severe in western New York and central and southwestern Michigan. There was an almost total absence of

* *Uncinula spiralis* B. & C.

† Les périthèces sont relativement rares en Amérique; ils ne se produisent jamais qu'a la fin de l'automne lorsque les grands froids brusques surviennent et cela seulement dans les régions du Nord; ils sont surtout fréquents dans la Nouvelle-Angleterre. Dans Missouri, le Texas, la Californie, on ne les observe presque jamais; ils sont rares dans la Virginie. Il semblerait donc que les froids rigoureux arrivant brusquement soient nécessaires à leur formation.—*Une Mission Viticole en Amérique*, p. 283.

‡ *Fusicladium dendriticum* Fkl.

ruit, and the foliage was dwarfed, distorted, and blackened to an extent never before observed, and to such a degree that the trees made a feeble growth, were much injured, and bore no fruit the following year. In September the leaves of whole orchards in southern Michigan looked as if fire had run over them, and some of the trees seemed ready to die. Both in New York and Michigan the disease was correlated with many weeks of almost continuous rainy weather, commencing in early spring before the trees blossomed. It is not known just what destroyed the apple crop, but the almost universal failure of the trees to set fruit was attributed to the rainy weather. The failure to set fruit in 1893 is almost certainly attributable to the physiological derangements of the preceding year. In localities outside of these areas of excessive rainfall apple scab was not more prevalent than usual.

PEAR BLIGHT.*

In Kent County, Md., pear blight started in, or at least was first noticeable, about the middle of June, and was unusually prevalent during two weeks of very moist, hot weather. Some growers removed wagon loads of blighted limbs. Mr. Robert Emory, of Chestertown, cut over his large orchards seven times and in this way saved many trees. The orchards of Dr. W. S. Maxwell, at Still Pond, escaped entirely, although only about 12 miles from Chestertown, and subject apparently to identical temperature and rainfall. The only blight in these orchards of recent years has been that introduced artificially by Mr. Waite.

This disease was also very prevalent in Kent County, Del., where similar meteorological conditions prevailed. In both localities the disease was so bad as to cause much comment. In western New York and western Michigan pear blight was not widespread or severe, although, as noted above, the spring in both places was very rainy.

GOOSEBERRY LEAF-BLIGHT.†

The leaf-blight of the gooseberry was unusually severe in Maryland and Michigan. The leaves began to fall two months in advance of the proper season, and in many cases the bushes became bare before the fruit was picked. At Hubbardston, Mich., part of the fruit failed to mature on account of this loss of foliage, and in various other places the disease cut short the crop and materially diminished the vigor of the plants.

BLACK SPOT OF THE PEACH.‡

This spot disease was common on peaches at Benton Harbor, Mich., in September, and a series of rains caused the affected fruits to crack open quite generally, as previously described in this Journal (vol. V, p. 33).

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* *Bacillus amylovorus* (Burr.) De Toni.

† *Glœosporium ribis.* (Lib.) Mont.

‡ *Cladosporium carpophilum* Thümen.

CERCOSPORA (?) ON PEACHES.

Badly spotted Crawford Early peaches were received from A. A. Crozier, Ann Arbor, Mich., and later in the year the same disease was observed by the writer on other varieties at Douglas and Benton Harbor, Mich. In the specimens from Ann Arbor the spots consisted of small, roundish, slightly elevated portions, with a dead, yellowish center, and a dark, purplish brown circumference. In the most typical specimen, not over one-eighth of the surface was pitted, but that bore 50 spots, giving to the surface a very measly appearance. The central dead portion of the spot did not exceed a diameter of one-half mm. and often it was less. In the specimens collected at Benton Harbor a central white spot was surrounded by dead, brown tissue, which was ringed in turn by deep crimson. There was a mycelium in the spots suggestive of *Cercospora circumscissa*, but all of the spots were sterile and the fungus was excluded from the living tissues by a thick layer of cork.

Comparatively few fruits were attacked, and this is the first time anything of the kind has come to my notice.

PEACH MILDEW.*

A variety called Arkansas Traveler mildewed badly on the farm of William Smithson, at Youngstown, N. Y. No other variety in the orchard was attacked, and no other was destitute of glands at the base of the leaf blade (see Jour. of Mycol., vol. VII, p. 90). As heretofore, no perithecia were found in connection with this mildew, even when the examinations were continued until winter, and its identification is still doubtful.

PEACH CURL.†

Peach curl was rather severe in southwestern Michigan along the lake shore. On uplands, some miles away from the lake, it was less prevalent.

The sudden appearance of this disease under conditions such as were described in *Field Notes*, 1891,‡ i. e., following a decided drop in temperature, is due, according to N. A. Cobb, solely to unusual deposits of dew, prevaling at such times, and affording special facilities for the germination of the spores and the entrance of the fungus.

WILTING OF PEACHES ON THE TREE.

At Benton Harbor, Mich., during a few days preceding September 22, many Hales Early peaches partially separated from their peduncles and shriveled, and even fell from the trees. This was just in advance

* *Sphærotheca pannosa?* (Wallr.) Liv.

† *Taphrina deformans* (Berk.) Tul.

‡ This Journal, vol. VII, p. 88.

of the time for picking, and the loss was very considerable. Hundreds of trees were affected, and there appeared to be no assignable cause, other varieties in the orchards "coming up" satisfactorily. In an orchard where the loss was severe the trees stood on a fertile upland of sandy loam, such as would produce an excellent quality of winter wheat. The trees had received good cultivation, and were well grown, thrifty, and full of fruit.

It has been suggested that this shriveling may be a varietal peculiarity, induced by exceptional meteorological conditions. If such be the case it is a strong argument in favor of discarding this variety altogether.

STEM AND ROOT TUMORS.

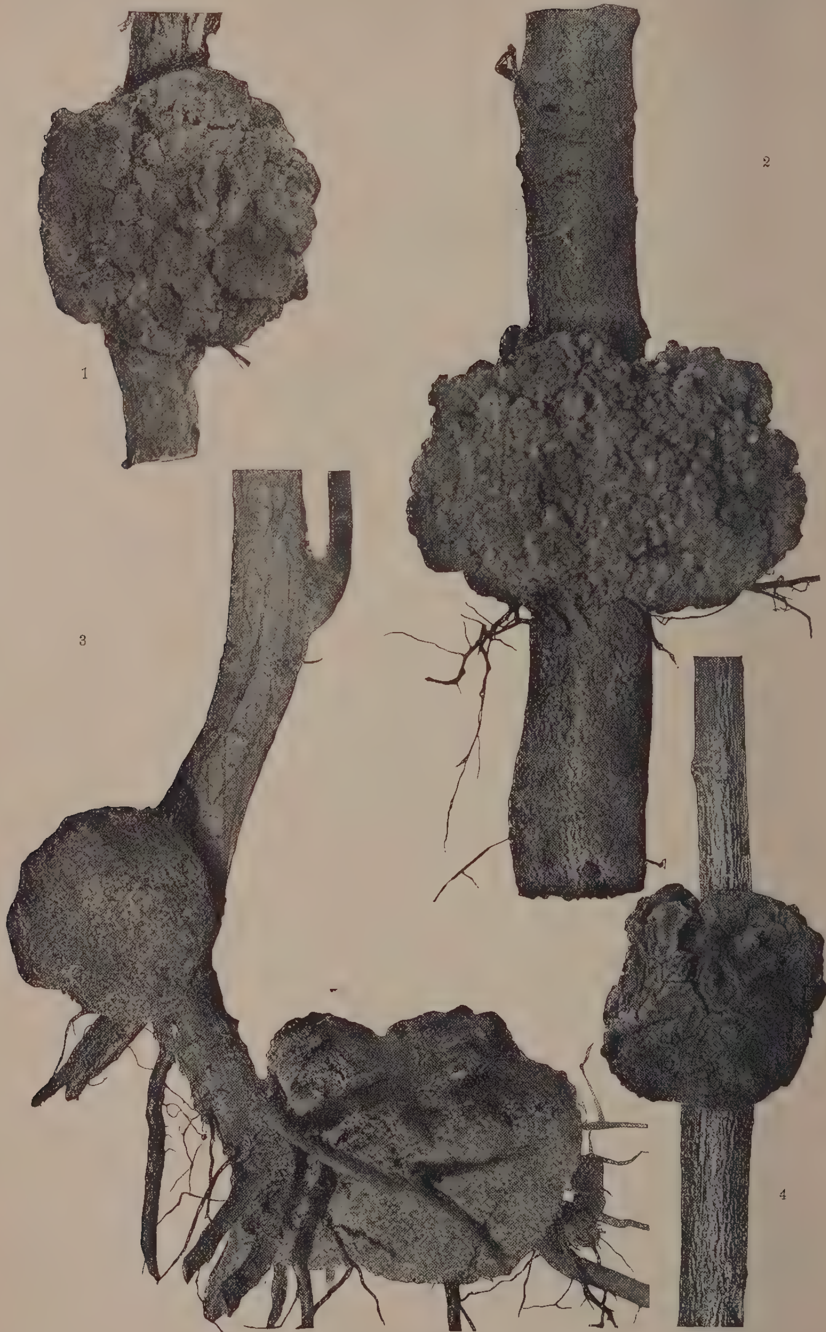
Tumors on the roots of peach trees have been found by the writer in several localities during the past few years, and have been reported from many parts of the United States. They occur on roots of all ages, and vary greatly in size, the largest ones being several inches in diameter. Usually these tumors are several to many times the diameter of the root, and are entirely unlike the small galls produced by nematodes. They also occur on stems above ground, peach trees thus affected having been received from Texas and Florida.

This disease occurs from New Jersey to Florida and westward to the Pacific, but at present it is most prevalent in Texas and California, where it is causing much anxiety. In California it attacks orchard trees as well as nursery stock, and seriously injures both. One nurseryman in southern California, writes as follows: "It attacks trees on dry and moist land in about the same ratio. I have found no conditions that will prevent it or any that will always black-knot a tree. I have had all of a certain lot black-knot and another lot alongside be almost free from it. My loss in nursery this year was 22 per cent. There is a great amount of it all over this State, and I think it is getting worse, many trees in bearing dying from the disease."

It has been observed by the writer on the peach, plum, almond, pear, and poplar, and it has been reported as occurring on the roots of other trees and shrubs, e. g., apricot, apple, fig, walnut, raspberry, blackberry, and vine, and root tumors of some sort certainly occur on these plants.

The inner tissues in young specimens of the peach and almond tumors appear to be entirely free from nematodes and fungi, bacteria, and phytomyxineæ, and their cause is involved in uncertainty. The most probable hypothesis is that they are due to some external irritant. Those who have the opportunity to examine early stages of this disease should certainly look for external parasites, especially animal organisms.

The general opinion of nurserymen who have had experience with this disease is that certain localities and often certain spots in a particular field are especially subject to it, and some believe it may be carried with the germinating seeds from the bedding ground into the



The Crown Gall.

nursery, and that the selection of a proper place for bedding pits is an important factor in getting rid of this disease. This belief rests on the fact that certain lots or blocks of trees are often specially subject to it while others are nearly exempt. The general appearance of these tumors on peach, pear, and poplar is shown in Plate XXXVIII. Some trouble has been experienced in finding a proper name for this disease, since the use of the term "root knot," which is already preempted for the root disease due to nematodes, would lead to endless confusion. In California this disease is sometimes designated the "crown gall," from the frequency of its appearance at the surface of the earth, and this name is, perhaps, as good as any, although the disease is not confined to this part of the tree.

ROOT ROT OF THE PEACH.

The specimen on which this report is based was received from Waco, Tex. The outer bark at the base of the trunk did not give indications of extensive injury, but on examination the entire inner bark was found to have been destroyed by a fungus which produced between wood and bark copious flat, white, mycelial strands, having a strong smell of mushrooms. Apparently the strands belonged to some hymenomycetous fungus, but there were no organs of fructification by which to identify it. The fungus may have entered the tree through two small injuries, which were probably due to borers, but the extent to which it had penetrated in all directions between the living wood and bark indicated that it was capable of living parasitically and that it was probably the cause of the disease. Trees attacked in this way are said to die gradually and usually first on one side. The top of this particular trunk showed signs of unhealthy growth in 1891, but matured a good crop of fruit. In 1892 it bloomed and set a fair crop, but died about the time the fruit ripened, part of the latter remaining on the tree in a withered condition.

Possibly this decay is the work of *Armillaria mellea*, but no rhizomorphs were found. At any rate it is a disease which has been reported only from the Southwest, no cases ever having been observed by the writer in the peach-growing regions of the northern and eastern United States, where peach yellows is prevalent and where we should expect to find such symptoms frequently if hymenomycetous fungi were the cause of yellows.

DESCRIPTION OF PLATE.

PLATE XXXVIII. The crown gall. Fig. 1, Lombardy poplar, crown affected, Arizona. Fig. 2, fresh pear stock, crown affected, Maryland. Fig. 3, peach, crown and roots affected, California. Fig. 4, peach, stem above ground affected, Florida. All photographs, natural size, from young trees.

REVIEWS OF RECENT LITERATURE.

ALTEN H., UND JÄNNICKE, W.—*Eine Schädigung von Rosenblättern durch Asphaltdämpfe*: <Bot. Zeit., 49. Jahrg., Leipzig, March 20, 1891, pp. 195–199; *Nachtrag zu unserer Mittheilung über "Eine Schädigung von Rosenblättern durch Asphaltdämpfe."* <*Ibid.*, Sept. 25, 1891, pp. 649–650.

What Prof. H. Marshall Ward has done for the parasitic diseases of plants caused by *Botrytis* has been accomplished by the authors of the present papers for a nonparasitic disease of rose leaves caused by asphalt vapor; that is to say, a rational and connected account has been given of the exact course of the malady. The rose leaves in a garden were injured in a very peculiar manner by asphalt vapor generated during the construction of a neighboring street. The injury was noticed in a strip running 150–200 meters southwest from the asphalt kettles. The injury was seen after a rain accompanied by a northeast wind. During clear weather no injuries were observed. The injured leaves showed a pronounced browning of the upper surface, became withered, and finally fell. In many instances the twigs bearing such injured leaves also died. A remarkable fact was that only the upper side of the leaves exposed to the rain were browned. Inverted leaves were browned on their under surface. When one leaf lay over another the under one was free from injury. Microscopic examination showed that only the epidermal cells were damaged, these having a brown, granular cell content. There was a great difference in the amount of injury to different plants; roses were injured most and then strawberries, while delicate-leaved begonias remained entirely sound. Such, in brief, were the symptoms of the disease, and to explain the exact manner in which the asphalt vapor caused the peculiar injuries was now the task of the authors. The action of poisonous gases (such as sulphurous acid) was excluded by the fact that only the upper surfaces of uncovered leaves suffered. Sections showed that there was no appreciable deposit on the upper surface of the leaf, and consequently the damage was not due to a body mechanically carried down and deposited by the rain on the leaves. It then became clear that the injury must be due to a soluble substance brought down by the rain and absorbed by the leaves. Curiously enough, the character of the epidermal wall seemed to exercise no influence in the matter, since delicate begonia leaves were spared, while coarse rose leaves, with thicker-walled epidermal cells, suffered. One thing, however, was soon determined, and that was that the injury stood in definite relation to some substance held in solution in the cell sap. The amount of injury to the cells was found to depend upon the amount of tannin contained in them. This explained why begonia leaves were exempt, for they

contained no tannin. It was now necessary to determine which constituent of the asphalt vapor caused the precipitation of the tannin.*

It was found that slight quantities of iron were contained in the vapor and that this caused the damage. The iron was supposed to be in the form of ferrous salts or possibly in the finely divided metallic state. In the "Nachtrag" the authors report the results of trials made to determine the effect of various iron salts on rose leaves. Metallic iron in suspension failed to produce the very evident coloring of the epidermal cells; ferrum redactum caused dark spots here and there, but ferrous and ferric chloride and ferrous and ferric sulphate in solution produced a dark coloration resembling that caused by asphalt vapor. All four solutions last mentioned, with the exception of ferric chloride, brought about a precipitation of the contents of the epidermal cells. Ferric salts also injured the chlorophyll grains, turning them yellow. These experiments confirm the authors in their supposition that the injuries to the rose leaves were due to iron present in the asphalt vapor. Such papers as this are genuine contributions to vegetable pathology, and it is to be hoped that their numbers will increase in the future.—W. T. Swingle.

Cooke, M. C.—*Handbook of Australian Fungi.* London, 1892, pp. xxxii, 458, pl. 36.

This volume, the latest of many that have appeared from the pen of Dr. Cooke, is a useful addition to the literature on fungi, and must be welcomed by all students fortunate enough to secure a copy. Only a limited edition has been printed, and the larger part of it has gone to Australia. The reason for this is manifest from the title page, for it is there stated that the volume is "published under the authority of the several governments of the Australian colonies," "for the Departments of Agriculture in Melbourne, Brisbane, Sydney, Adelaide, Hobarton." The value of the book does not arise from any novelty of arrangement or description of new species, but in its being the collection of descriptions scattered through many widely distributed and frequently nearly inaccessible papers and monographs. It embodies the latest views of the author in regard to classification, a subject now receiving general attention from students. As will be seen, Dr. Cooke is not in entire accord with some of the newer schemes presented for acceptance.

* It is probably the weakest point in the paper that this tannin (Gerbstoff) was not more carefully studied. Le Merchant Moore has shown (On Epidermal Chlorophyll, Jour. of Bot., vol. xxv, p. 362) that the epidermis of some plants contains a substance giving the reactions of tannin with iron salts, but showing a blue or purple color with iodine and failing entirely to give the reaction for tannin with potassium bichromate, either alone or with iron salts and Millon's reagent. Kraus, however, considers this a tannin, but Dufour (Recherches sur l'amidon soluble, Bull. Soc. Vaud. d. Sci. Nat., vol. xxi, No. 93, 1886) regards it as a carbohydrate. Reinitzer (Der Gerbstoffbegriff. <Lotos, neue Folge, 11, 1891) insists that simply calling a substance tannin tells almost nothing of its real nature, especially in a case like this, where we are in doubt as to the exact reactions it gives.

The total number of species represented in the volume, exclusive of varieties, is 2087.* This, in comparison with the total number of species recorded by Saccardo, some 36,000, seems, and is, small, when the whole extent of the country covered is taken into account. But it is of course very improbable that all the Australian forms have been described. Indeed, scarcely a month passes but some new species are recorded, and it is probable that they will continue to be sent in for many years to come. The various orders are represented by species as follows:

Hymenomyceteæ	1,178
Gastromyceteæ	174
Ascomyceteæ	341
Phycomyceteæ	12
Hypodermeæ	103
Sphæropsideæ	114
Hyphomyceteæ	117
Myxomyceteæ	48

The largest order, Hymenomyceteæ, probably occupies this place because of the generally large size of the plants embraced in it. These being easily seen are naturally collected. At the same time the second order, Gastromyceteæ, has 174 out of a total known from the whole world of 650 species. "From this we conclude," Dr. Cooke remarks, "that Gastromycetes are unusually strong in Australia, certainly including some interesting genera not hitherto discovered elsewhere, but weak in subterranean species."

The occurrence of a number of species in Ceylon and Australia is noted as a curious fact in geographical distribution. For example, numerous species of *Lepiota*, a subgenus of *Agaricus*, occur in both places; others, like *Kneiffia mulleri*, *Hymenochæte strigosa*, *H. rhabarbarina*, *Stereum pusillum*, *S. sparsum*, *Coniophora murina*, *Aseröe zeylanica*, and *Epichlöe cinerea* are found nowhere else than in Ceylon and Australasia. Comparing the flora with that of Europe, Dr. Cooke finds that of the Hymenomycetes 332 are exclusively Australian, 472 are Australian and European, and 370 are common to Australia and some other country exclusive of Europe. Of the Gastromycetes only 31 out of 173 species are European. The Myxomycetes are still regarded as fungi, notwithstanding the efforts to separate them as *Mycetozoa*.

A useful portion of the introduction consists of condensed accounts of the principal groups, with tables of the genera. This, while not claiming to be complete, can not but be of assistance in recognizing the larger groups and the genera. The species will have to be studied up from the descriptions. These, however, are well supplemented by 36 plates, with 377 figures. Twenty plates, with 175 figures, are colored.

* The slight discrepancy between this number and that given by Dr. Cooke in the introduction is due to the addition here of a few interpolated and duplicate numbers left out of his count in the general total.

These include the three groups, Hymenomycetes, Gastromycetes, and Discomycetes. In the second of these are some peculiar Phalloids and Lycoperdaceæ. Among the latter is *Podaxis indica*, which bears a surprising outward resemblance to *Coprinus comatus*, although, of course, the interior structure is widely different. There is also *Xylopodium ochroleucum*, with a long stalk and a peridium marked with angular projections.

Only one change seems to have been proposed in nomenclature. This is the substitution of *Platycheilus* for *Tryblidiopsis*, preoccupied. A list of authorities cited and a full index are valuable portions of the book. The descriptions of the plates would have been more convenient for reference had the pages where each species is described been given.—JOSEPH F. JAMES.

HABERLANDT, G.—*Eine botanische Tropenreise: Indo-Malayische vegetationsbilder und Reiseskizzen.* Pp. VII, 300, fig. 51. Leipzig, 1893.

An account of a six months' trip from Triest to Java via Bombay and Singapore, and return via Ceylon and Egypt. Most of the time, November to February, was spent in the hot, rainy region of West Java, where the yearly rainfall is 4½ meters, and the mean annual temperature 25° C., with a difference of only 1° between the mean of the warmest month, September, and that of the coldest, February. In spite of what would seem to be favorable conditions, parasitic fungi in West Java are comparatively rare. The author thinks this may be due to the fact that the spores do not find lodgment, the foliage on a great many plants being thick, hard, and smooth, so as to be washed clean by the daily rains and quickly dried. If the leaves were hairy, so as to hold the spores and retain moisture, the opportunities for attack would be better. In some of the thickets the growth from the interweaving of lianas is so dense that fallen branches and foliage do not reach the ground, but gather in masses, like thatch of roofs, and over and through these, anchoring here and there, clambers the black and brown liana-like mycelium of a fungus resembling *Marasmius*—fungus-lianas, the author calls them.

During the nine days spent in Ceylon the following facts were gathered relative to the coffee rust (*Hemileia vastatrix*). The extensive and beautiful coffee plantations so graphically described by Haeckel, have been almost entirely destroyed and the land is now devoted to other purposes, e. g., tea-growing. The first coffee plantation was set out in 1825, and the business proved so remunerative that a vast extent of upland country was devoted to it, and coffee-growing and speculation became the rage. The leaf rust appeared in the seventies, and no radical means were found to check its rapid spread. The influence of this disease was felt in every branch of business and a great many people were financially ruined. Many of the plantations can now be had for one-tenth their former value, and the total depreciation in real estate

is estimated by the German Consul General, P. Freudenberg, at about ten million pounds sterling. This disease also occurs in Java, but its ravages there have been partly offset by the introduction of a more resistant species of coffee, *Coffea liberica* from West Africa, which also yields more fruit and endures the hot Javan climate very well, even down to the coast.

Both in India and Java variegated plants are common and are used for ornamental purposes so extensively as to form a characteristic and striking feature of the garden landscape.—ERWIN F. SMITH.

MAYER, ADOLF.—*Ueber die Mosaikkrankheit des Tabaks.** <Landw. Ver. Stat., vol. XXXII. Berlin, 1886, pp. 451-467, pl. 1.

Tobacco plants in parts of Holland are subject to a variegated leaf disease. This is sometimes so serious as to take the whole crop, but ordinarily only scattered plants in the field are affected and there is no indication of infection from plant to plant, although sometimes several affected plants may be together.

The disease generally appears three to five weeks after the plants have been set out, when they are well rooted and have begun to grow vigorously. The first symptom is a geographic or mosaic coloring of the leaf surface, light and dark green, but otherwise the leaf appears sound. Soon with assistance, and a little later to the naked eye a considerable number of thickenings are visible in the green spots. These green spots grow so much more than the pale places that there are numerous irregular bendings of the leaf surface. Finally the light parts die early. The dark parts of the leaves also take on in later stages of the disease a transparent and lac-colored shade. When a single leaf is attacked all the younger leaves are sure to be, but at first only show earlier stages. The injuries caused by the disease are:

(1) Limitation of growth and a smaller harvest in consequence.

(2) Curling (wrinkling) of the leaves and unsuitability for cigar manufacture.

(3) Brittleness with the same result.

(4) Imperfect ripening and therefore incomplete (*schlechter*) burning, also injury of the aroma, so far as this can be said of any European tobacco. Once only the author found a little of the disease at Karlsruhe, in south Germany. The growers call the disease bunt, rust, and smut. The name "mosaic disease" was given by Dr. Mayer.

Dr. Mayer undertook a prolonged investigation to determine the cause of this disease. The opinions of practical men as to the cause were extremely diverse. The attention of the experiment station (Rÿksproef

*This paper appeared some years ago, but seems to have been generally overlooked by botanists, owing to its place of publication. The subject is one of much interest and it is believed that readers of the Journal will be glad of an abstract. A recent letter from Dr. Mayer states that no microorganism has yet been isolated from the affected plants.

Station zu Wageningen) was first called to this disease in 1879 by the transmission of healthy and diseased leaves, with the inquiry: "Was mag der Grund sein, dass in den letzten Jahren die Tabakspflanze so sehr leidet durch den sogenannten Rost?"

A comparative chemical analysis was first made of healthy and diseased leaves. This showed no lack of N, K, or Ca in the diseased leaves. In tobacco culture there is under ordinary conditions no lack of P_2O_5, because the plants make only moderate demands on this substance, and in the culture methods here in vogue an excess is given to the soil. Analyses of the earth from tobacco-sick fields also showed that there was no deficiency of plant food. Tobacco is known to be very greedy for lime, and consequently a sick earth and one not subject to the disease were compared. The lime content was small in both, but not essentially unlike. These determinations, combined with the results reached by experienced growers, seemed to show that the disease was not due to defective nutrition.

A search was then made for nematodes in healthy and sick earth. Some were found, but only such as live in humus, and no connection between them and the disease was established.

Plants were grown in specially constructed seed beds, with varying temperatures, degrees of moisture, and amounts of nitrogen, and their behavior after transplanting closely watched. They all developed normally, remained healthy, and were very fine at the end of summer, but not so large as those grown in the regular way and set out somewhat earlier. The plants were also set out with twisted and injured roots, but this was harmless. All grew into fine plants.

Plants were also grown at high temperatures in moist air and suddenly transported to the field. No disease resulted.

The hypothesis that crowding and etiolation in the seed bed might be a cause of the trouble was also tested and found wanting. In 1881 the disease was common, and the author had good opportunity to study it near Wageningen and Rhenen. Here for the first time it was observed that foreign kinds of tobacco escaped the disease entirely, while the disease was not completely absent from any of the sorts commonly grown.

In 1882 various experiments were made to determine whether self or cross-fertilization played any part. Plants from the seeds of diseased plants were also grown. None of these experiments had any influence on the disease. As usual it appeared on land subject to it and did not appear in other places. All these results seemed to indicate a disease due to parasites.

The tissues were searched zealously for fungi, animal parasites, etc., not only by the author, but also by several of his friends. At first no results were obtained. Only one authority thought he found a mycelium in the diseased parts of the leaves, "die sich zu einer Septoria oder Phoma entwickeln dürften." It was at this time Dr. Mayer discovered

that the disease could be induced in healthy plants by inoculating them with the expressed juice of diseased plants. By rubbing up a plainly diseased leaf in a few drops of water, taking up a little of this thick, green emulsion in a glass tube drawn out to capillary size, and sticking it into the thick midrib of an old leaf so that it remained without reaching through to the back side, sound plants became badly diseased in nine cases out of ten. The period between the inoculation and the first doubtful symptoms was quite regularly ten to eleven days. After this period the disease appeared without failure in all the younger leaves, i. e., those undeveloped at time of inoculation, and on the small shoots which developed in the axils of the diseased leaves. All the younger parts of the plants were diseased, exclusive possibly of the flowers, and all the older parts healthy.

It is self-evident that the disease is more severe in proportion to the youngness of the plant at the time of inoculation. It is much less dependent apparently on the quantity of inoculated substance (*Impfstoffs*). It is only necessary to be careful that the substance is really taken up by the plant, and this is best brought about by using a thin fluid and infecting slightly wilted plants.

After this discovery organized bodies were sought in the sap of the diseased plants with new zeal, but owing to the numerous almost colorless granules normally present in the juice no definite results were obtained. Some of these granules were not unlike red blood corpuscles, but more half-moon shape, while others were smaller. The sap was also rich in small tetrahedral bodies, which slowly disappeared in HCl, and which were probably calcium oxalate. The bodies in the sap appeared, even with the highest powers, of such indefinite form that they could not be identified with any certainty as organized bodies.

Later Dr. Mayer endeavored to isolate the supposed organisms by Koch's and other methods, and demonstrated bacteria in many cases. But none of these, when used for inoculation, caused the disease. He also inoculated sound tobacco with various bacteria, dung solutions, extract from tobacco, sick earth, etc., but without result.

The question now arose whether the disease was due to an organized or a chemical ferment. A chemical ferment seemed improbable. This sort rarely causes a disease, and it is unheard of that an enzyme multiplies from itself. An organized ferment might be a fungus or a bacterium. To determine these points the following experiments were undertaken:

The infectious fluids were passed through ordinary filter paper and the filtrate used for a large number of additional inoculations. Result: The filtered sap worked almost as well as the unfiltered. The per cent of diseased plants was only a little less. Either the disease was due to chemical substances or else to organized bodies small enough to pass through the pores of the paper. A clear filtrate was finally obtained by using a double filter, and fluid passed through this possessed no infective power. Evidently the cause of the disease was

filtered out and could not be a chemical ferment, for it is opposed to all known peculiarities of enzymes to be filtered out of solutions. The common method for the concentration of an enzyme, i. e., precipitation with not too strong alcohol from the crude juice and re-solution in water, was tried. This led to no substance which had infective power.

Inoculations with heated sap led to the following results: Persistent warming at 60° did not perceptibly alter the infectious power; at 65° to 75° it was weakened. Heating the sap at 80° for several hours killed the infective power. These experiments show that the infective substance satisfies the requirements of an organized ferment, and indicate that the infective body must be searched for among the small organized bodies. Fungi are much too large to pass through filter paper, and if the disease was due to these it would seem that they must assume at some stage some more easily visible form.

The following is a rather literal rendering of the author's conclusions:

(1) The "mosaic disease" of tobacco is a bacterial disease, the infective organism of which has not yet been isolated so as to know its form and mode of life.

(2) The infective power of the disease from plant to plant under the artificial conditions of sap mixture has been established with certainty. Under natural conditions there is no plain infection from plant to plant. The seeds of diseased plants can produce sound plants.

(3) The cause of the disease must be sought in the earth of the tobacco fields and the hotbeds, for particular fields, especially those in which tobacco follows tobacco, are most exposed to the disease. A case of transportation of the disease with earth, however, was not established.

Rotation of crops is advised, also the removal of the diseased plants, and after harvest all remnants of the crop.—ERWIN F. SMITH.

MOELLER, H.—*Entgegnung gegen Frank, betreffend den angeblichen Dimorphismus der Wurzelknöllchen der Erbse.* <Ber. d. Deut. Bot. Ges., Bd. x, Nov. 24, 1892, pp. 568-570.

In a recently published note upon root tubercles, Frank states that those of the pea show two forms that differ externally, but have the same internal structure, and furthermore that the content is different, being albumen bacteroids in the one, and amylodextrin bacteroids in the other.

The author of this paper proved some time ago that these tubercles do not contain amylodextrin, but a waxy substance, and this fact made him doubt the correctness of Frank's observations. He has also studied the exterior form of such tubercles and states that vigorous specimens of pea show a considerable variety of such tubercles, but without any distinction of two special forms. An examination of their contents gave only albumen bacteroids. These investigations were

made when the plants were at the end of their vegetative period, while those of Frank were made shortly before their flowering, a fact that might have led to the difference in results.

In *Trifolium* the tubercles are developed all the year round without being dependent upon the growth of the plant. It would appear that the biological process in these tubercles consists in the bacteria becoming transformed into bacteroids by a certain kind of hypertrophy, and that when dead the organisms are resolved into a fatty substance. The author is unable to believe in anything like a reabsorption of the bacteroids. The result of his examinations shows that the tubercles are not to be differentiated, either in their shape or in regard to their contents; thus no dimorphism is observable.—Theo. Holm.

Report on recent experiments in checking potato disease in the United Kingdom and abroad. London, 1892, pp. 193, figs. 5.

Notwithstanding the fact that the potato is the standard crop, constituting the larger part of the food of the people of Ireland, and is an important product of England and Scotland; that the vegetable is known to have been affected by fungi since 1844; that the disease has in some years been so severe as to cause tremendous losses and even a famine in Ireland; and that for the past six years the disease has been known to be successfully combated by copper compounds, still the authorities of Great Britain do not seem to have made any attempt to prevent the disease by treatment with these compounds until 1891. It is true that when the results of experiments made in France in 1888 became known, the attention of the Government was called to them, but without any result, save the issuance of a report or two. In 1891 the Royal Agricultural Society of England began to make some experiments. The board of agriculture also began to bestir itself and to inquire of foreign consuls what progress had been made in checking the disease. The results of the experiments and inquiries are embodied in the report at present under notice, and which was issued by the board of agriculture in the spring of 1892.

The report is divided into four parts: Part 1, contributed by Charles Whitehead, consists of a history of the disease; its cause; the life history of the fungus; and the action of "bouillie bordelaise," or Bordeaux mixture, as it is commonly called. From this introduction it appears that although in 1846 Berkeley had shown the disease to be caused by a fungus, agriculturists generally up to as late a date as 1872 believed the fungus to be the effect rather than the cause. This is shown by the fact that out of ninety-four essays submitted as the result of an offer of £100 for the best account of the trouble and its remedies, not one was deemed worthy of the prize, and not one contained correct ideas as to its origin. This is certainly remarkable when we remember the number of able botanists which England possesses and the demonstration by Berkeley twenty-five years before. The idea also at one time pre-

vailed that there were disease-proof varieties of the potato, but this was speedily disproved by experiment. In the discussion of the action of Bordeaux mixture the rather remarkable statement is made (p. 22) that "at present there are no clearly defined formulæ." It is difficult to understand how anything can be made more definite than the formula given for the Bordeaux mixture in Circular No. 4 of the Section of Vegetable Pathology, U. S. Department of Agriculture, issued in July, 1889. While the formula has since been modified, the directions there given were sufficiently explicit.

The second part deals with the experiments conducted by the Royal Agricultural Society in Great Britain and Ireland in 1891. These experiments were made in various places and under varied conditions, and the results were not in any way uniform. In some no benefit was reported, while in others it was very marked. The general conclusion reached, however, was that when applied at the proper time and in the proper way a decided benefit was derived from the use of Bordeaux mixture.

The third part deals with the experiments for checking the disease and the culture of the potato in foreign countries. Eleven questions were submitted to the representatives of Great Britain in Austria-Hungary, Belgium, Denmark, France, Germany, Netherlands, and the United States. These questions related to the varieties usually grown, changes of seed, methods of seeding, frequency of cropping, manner of cultivation, manures used, occurrence of disease, precautions taken against it, measures to prevent its appearance, remedies adopted, and the results of the treatment. We have here a digest of the experiments made in the countries mentioned, and it is valuable as a compilation of late information. The experiments in France, Belgium, and Holland are especially referred to, and in some cases given in full. Part 4 gives a summary of reports on potato culture in the colonies, mainly those of Australia, where, however, the disease either does not exist or does but little damage. It occurs to a greater or less extent in the Bermudas and on the Cape of Good Hope.—JOSEPH F. JAMES.

SARAUW, G. F. L.—*Rodsymbiose og Mykorrhizer særlig hos Skovtræerne.* <Bot. Tidsskrift, vol. XVIII, Copenhagen, 1893, pp. 134, pl. 2.

The present paper contains a complete account of the various theories and explanations which have been given of the "root symbiosis and the Mycorrhizæ." It contains abstracts of a large number of papers from the earliest up to the present time, while the original investigations of the author are merely alluded to. It should be pointed out that the present paper represents only the historical part of a comprehensive work entitled "Bögens Svamprödder," for which the author was awarded the prize of the Royal Danish Academy of Sciences.

The various forms of parasitism are discussed as "antibiosis" and "symbiosis," terms which were proposed by Vuillemin (1889), and which

correspond to the difference between "antipathy" and "sympathy." The author defines, however, the "antibionts" to be those beings which live in a constant struggle with each other, while the "symbionts" live in peace and do not cause any injury to each other. Whether these "symbionts" are of any mutual benefit is another question. This conception of symbiosis was given by Tubeuf in 1888, who called it "harmless symbiose."

It is a marked characteristic of the antibionts that their action very soon ends the struggle, and their appearance is, therefore, rather limited. The symbionts, on the other hand, may be observed as constant companions for many years. Antibiosis and symbiosis may, when considered in this way, represent an acute and chronic parasitism.

The chapter dealing with the appearance of the "root symbiosis" comprises the "algal symbiosis," as we know it from the lichens and Hepaticæ, and the "fungal symbiosis," which causes the development of root tubercles and similar hypertrophy of roots or organs which have the same function as the proper roots, such as fronds with rhizoids like those of Hepaticæ, etc. It seems as if Dalechamp (1587) was the first to describe and figure the root tubercles of the Leguminosæ, while Malpighi (1679) also described them, and considered them as galls, caused by insects. Concerning the morphological identity of these tubercles, the Danish botanist Didrichsen (1867) explained them as being lateral roots. The anatomical structure was given by Van Tieghem (1888), who showed that they differ from normal roots by having several central cylinders within a common bark. Their first development is, however, to be traced, as in normal roots, from the pericycle of the mother root. But besides the Leguminosæ, several other plants are mentioned as having similar tubercles, both trees and herbs, from the cycads and conifers to the annual *Junci* and *Cyperus flavescens*. The identification of most of the fungi which cause these various hypertrophies, is a very difficult task if indeed a possible one. Only a very few are known thoroughly, such as *Frankia*, *Rhizobium*, etc.

Frank was one of the earliest writers in the field and has written much. He appears to have been the first to demonstrate one phase of the question as to the biological importance of the fungal symbiosis. This author claims that certain trees, especially all the Cupuliferæ, are unable to take nourishment from the soil by themselves, but that they become nourished by means of the fungous mycelia which surround their entire root system and nurse them from their earliest stage until their death.

Gibelli, on the other hand, considers this symbiosis as a mere question of tolerance on the part of the root, and if we consider the entire literature upon this subject, it seems as if the majority of authors agree with Gibelli, that the fungus is tolerated by the root only because it does not cause it any injury.—THEO. HOLM.

Tavel, F. von.—*Vergleichende Morphologie der Pilze.* Jena, 1892, 8vo, pp. 11, 208, figs. 90.

This book puts the whole Brefeldian system into such a compact and lucid form that he who runs may read. The revolutionary work done by Dr. Brefeld and his assistants during the last twenty years in every group of fungi and embodied in ten large "Heften," with more to follow, is here condensed into less than 225 pages, and yet completeness and perspicuity of expression, so far as regards essential features, are everywhere apparent. That Dr. von Tavel is well fitted for this task goes without saying, since he was Dr. Brefeld's assistant for a number of years, and is joint author with him of Heften IX and X on Hemiasci and Ascomycetes.

According to the views here set forth, fungi consist of two primary groups: (1) The Phycomycetes, or algal fungi, consisting of a single cell and having sexual functions; and (2) the Mesomycetes and Mycomycetes, or higher fungi, consisting of a many-celled thallus and entirely destitute of sexual organs. The Phycomycetes have a thallus resembling that of the Siphoneæ and were undoubtedly derived from the algæ. They subdivide naturally into two quite distinct groups, the Oomycetes and Zygomycetes. The Oomycetes resemble the Oophyceæ both in the thallus and in the reproductive system. In each group the organism consists of a nonseptate, sparingly branched cell, which reproduces sexually by antheridia and oogonia, and nonsexually by swarm spores developed in sporangia. But the Oomycetes show degenerations and retrogressions which appear to be adaptations to a more terrestrial life. Especially noteworthy is the progressive loss of sexuality.

The group is divided into six families, including Entomophthoreæ, which stands midway between Oomycetes and Zygomycetes, having reduced antheridia and oogonia which conjugate, and an abundant conidial fructification. Beginnings of conidial fructification also appear in some of the other families. In Zygomycetes the thallus is one-celled and agrees completely with that of the Oomycetes, but the fructification is different. In this group there is still further degeneracy in the sexual reproduction. Instead of the union of specialized sporangia (antheridia and oogonia) to produce the zygospore, there is simply a conjugation of the slightly differentiated beginnings of such sporangia, i. e., the conjugating threads are only slightly swollen and the male and female organs can not be distinguished. Nonsexual sporangia are present as in Oomycetes, but the spores have lost their cilia with the more decided adaptation of these plants to a dry-land life. In the possession of a one-celled thallus the Zygomycetes are also like the algæ, and they resemble the Conjugatæ in conjugation, but not otherwise. The first five families are exosporangic, producing sporophores anywhere on the mycelium; the other two, Rhizopiæ and Mortierellaceæ, have progressed a step further and are carpo-sporangic, bearing their sporophores on specially

differentiated, stolon-like threads, which arise from the ordinary mycelium.

The higher fungi, i. e., the most highly developed, consist of the Ascomycetes and Basidiomycetes, or so-called Mycomycetes, and the intermediate Hemiasci and Hemibasidia, the so-called Mesomycetes, connecting the higher fungi with the Phycomycetes. The sexual organs, which are destitute of function in some of the Oomycetes and still further degraded in Zygomycetes, disappear altogether in the higher fungi and are not found even in a rudimentary state, whereas nonsexual methods of reproduction take on a compensating multiplicity of forms. Originally the nonsexual form was a sporangium, as in *Mucor mucedo*, and its change into a spore (conidium) can be followed step by step through the Thamnidiæ and Chætocladiaceæ. In the Choanephoreæ the conidia are still accompanied by the sporangia, but in the Chætocladiaceæ the latter have disappeared, and it is precisely from this group of Zygomycetes that the Basidiomycetes appear to have arisen. From this point of view there are three types of Zygomycetes: (1) Forms with sporangia only, (2) forms with sporangia and conidia, (3) forms with conidia only. Among the sporangial forms, moreover, *Mortierella rostafinskii* shows a distinct advance into a sporangial fruit, the beginning of which may be seen even in Rhizopeæ. Finally, in *Chlamydomucor racemosus* there has developed an additional, purely accessory spore, the chlamydospore, which occurs either as a chlamydospore proper or simply as an oidium. As already stated, all of these nonsexual spore forms, sporangial, conidial, and chlamydosporous, occur in great variety in the higher fungi. In the Hemiasci and Ascomycetes we have forms which fructify in sporangia only, or by sporangia and conidia, and these may be designated the *sporangial series* of the higher fungi. On the contrary, in the Hemibasidia and the Basidiomycetes there are no sporangia, but only conidia. These fungi evidently had their origin in the Zygomycetous Chætocladiaceæ and may be designated the *conidial series* of the higher fungi. Chlamydospores occur in both, and both sporangia and conidia are modified and specialized. The sporangium in Zygomycetes varies as to form, size, and number of its spores in the same species, but in the higher fungi definiteness becomes more and more pronounced until in Ascomycetes the sporangium becomes an ascus having a determinate shape and bearing a definite number of spores. In these particulars the Hemiasci form a transition group, their sporangial fructification being ascus-like, but more variable than in Ascomycetes. In the conidial series it is the conidiophore which has become specially developed. In Zygomycetes also the conidiophore varies in form, size, and number of its spores. In the Basidiomycetes it has been specialized into a basidum of definite form and bearing a definite number of spores. Here, again, there is an intermediate group, the Hemibasidia, connecting the basidia-bearing forms with the much simpler Zygomycetes. The accessory spore form, i. e., the chlamydo-

spore remains indefinite in both series. According to this view, all of the higher fungi had their origin in Zygomycetes, and the two series simply developed in different directions, one series excluding sporangia and developing specialized conidiophores (basidia), while the other series retained indefinite conidiophores, but developed sporangia of a very precise character (asci).

The Hemiasci consist of three families, (1) Ascoideæ, (2) Protomycetes, and (3) Theleboleæ. In these simple forms the sporangium becomes ascus-like, but is still indeterminate as to form, size, and number of its spores. The spores are usually shot out with considerable force, showing in this particular a greater adaptation to terrestrial life than is found in most Zygomycetes. The Ascoidæ have free sporangia, as in Mucor, and conidia. The Protomycetes also have free sporangia and conidia, but the former are preceded by chlamydospores. The Theleboleæ have sporangial fruits, the condition seen in *Mortierella rostafinskii* having been carried a step farther by the reduction of the sporangiophore to a mere rudiment and the extension of the basal weft of mycelium into an envelope.

The Ascomycetes are characterized by the presence of the ascus, which is simply a sporangium that has become determinate in form, size, and number of its spores. In very many cases this form of fructification is accompanied by conidia and chlamydospores. When ripe the spores of most Ascomycetes are shot out of the ascus with great energy. Sexual organs do not occur in any of the forms, and the earlier observations ascribing sexuality to various Ascomycetous fungi are misinterpretations. The Ascomycetes are divided into Exosporangial and Carposporangial forms. The Exoasci are the simpler, having naked asci, borne directly on the mycelium. They include two families, Endomycetaceæ and Taphrineæ. The Carpoasci, which form the bulk of the Ascomycetes, have fruit bodies. The asci are not naked and do not arise directly from the mycelium, but in special organs, which are composed of fertile or asci-bearing hyphæ, and of sterile threads, which form the walls of the envelope. In most cases asci are not borne singly, but in great numbers in a hymenial layer. The simplest ascus fruits are angiocarpous. In the more highly differentiated Pyrenomycetes they have a special ostiolum. In another series of forms, i. e., Hysteriaceæ and Discomycetes, the fruit body may be called gymnocarpous, being closed at first but afterward open. Of much importance in the Carpoasci are the accessory fruit forms. In addition to ordinary free conidia and chlamydospores, there are conidia which have reached a higher grade of development, being produced within special fruit bodies resembling ascus fruits (the pycnidia). Still another fruit form is possible in this group, but has not been found, viz, ordinary sporangia. The simplest form of conidia appears in the Taphrineæ, being developed directly from the ascospore, even before its escape from the ascus, or else from another conidium. The next advance is the production of a germ tube on which

the conidia are borne. From this it is but a short step to mycelium, bearing conidia anywhere on its surface, a common occurrence in the Carpoasci. From simple forms like these the conidial development can be traced through coremia and more complex stroma-beds into its highest specialization, the closed fruit bodies known as pycnidia. Pycnidia are symphogenetic or meristogenetic according as they are pseudoparenchymatous, i. e., developed from a hyphæ complex, or produced by ordinary cell division, a common method in many cases. Between these two extremes are numerous intermediates. Free conidiophores, as well as conidial fruits, bear, as a rule, only one sort of spores, but sometimes, as in Diaporthe, the last produced may be of a different shape from the first. Succedaneous spore formation is regarded as a lower type than simultaneous, because the latter is more restricted. Chlamydospores appear in the Carpoasci in two forms, viz, as true chlamydospores and as oidia, but neither one is very common. Although the ascus is the highest type of fructification in this group, it is relatively the rarest. Often the fungus reproduces itself for many generations without developing asci, and for this reason many conidia and chlamydospores have been classed among the *fungi imperfecti*, the free conidiophores, as Hyphomycetes; the conidia beds as Gymnomycetes; and the pycnidia as Sphæropsidiæ, Cytisporaceæ, and Phyllostictaceæ. In many cases an exact determination of their place in the natural classification is possible only when identical forms are obtained from ascospores by artificial cultures, but the constant occurrence of two forms together renders their genetic connection probable. A great number of the Carpoasci live parasitically on algæ, forming lichens. The most of these are Pyrenomycetes and Discomycetes. In some lichens the alga forms the greater part of the thallus; in others, the fungus. Ascending from simple to complex forms, the Carpoasci are classified into (1) Gymnoasci, (2) Perisporiaceæ, (3) Pyrenomycetes, (4) Hysteriaceæ, (5) Discomycetes, and (6) Helvellaceæ. Sixty-five pages are devoted to the Hemiasci and Ascomycetes, each one pregnant with new views or interesting observations; but some of the most important statements are to be found in the last part of the book, dealing with the second or conidial series of the higher fungi. Here divergence from earlier views of classification is the most pronounced.

This series fruits exclusively by conidia. Beginning with certain Zygomycetes, the evolution of the conidial fructification can be traced step by step through the Hemibasidia into the Basidiomycetes, where it reaches the highest stage of development by the conversion of the indefinite conidiophore into the definite basidium. Chlamydospores occur in the Hemibasidia as well as in the Hemiasci, but while in the Protomycetaceæ the chlamydospores always grow out into a sporangium; in the Hemibasidia they grow out exclusively into conidiophores. All Hemibasidia have two kinds of spores, conidia and chlamydospores. The latter are constant and are the most striking spore forms, which is

also true in Protomycetes. The chlamydospores produce a sporophore, as in Chlamydomucor, but while it is accidental there, it is constant here, and while there it is a sporangiophore, here it is a basidium-like conidiophore. This intermediate group connecting Zygomycetes with Basidiomycetes separates naturally into two sub-groups, Ustilagineæ, with septate conidiophores (promycelia) bearing conidia chiefly on their sides; and Tilletiæ, with undivided conidiophores (promycelia) bearing the conidia in a whorl at the apex.

The Basidiomycetes are a very large group, rich in forms. Their most important character is the possession of basidia. The basidium is a conidiophore, which has become definitely restricted in shape, size, and the number of its spores. While an ordinary conidiophore produces spores one after another, indefinitely, from any suitable part, the basidium produces only a definite number of spores, only once, and in a particular place, and after their separation it shrivels. There is also less variation in the size and shape of the individual spores. Only in rare cases do the basidiospores become several-celled before their separation from the basidium, and this, as in similar cases elsewhere, is to be looked upon simply as an anticipation of germination phenomenon. Most basidia bear 4 spores; rarely they bear 2, 6, or 8 spores. These variations may all occur in the members of a single genus, e. g., Hypochnus. As a rule the basidiospores are borne on comparatively long sterigmata. Like the Hemibasidia, the Basidiomycetes are separable into two corresponding, but more highly developed groups. In order that the basidium-like conidiophore of the Ustilagineæ shall become a true basidium, its septa must be limited to a definite number, the position and number of sterigmata must also become definite, and finally only a single spore must be abjuncted from each sterigma. This is exactly what occurs in the Protobasidiomycetes, the first of the two subdivisions. The second and higher group consists of the true or Autobasidiomycetes, corresponding to the Tilletiæ; i. e., they have nonseptate basidia, but bear a definite number of basidiospores. In contrast to the Ascomycetes, naturally separable into Exoasci and Carpoasci, the formation of the fruit body in the conidial series is of secondary importance. Both Proto and Auto basidiomycetes begin with acarpous fruits, and from these have been developed the more highly organized forms having fruit bodies. The Protobasidiomycetes, or fungi having a septate basidium, are separable into four distinct groups: (1) Uredineæ, having horizontally septate basidia, always free, never borne in fruit bodies, and always produced from a chlamydospore (teleutospore); (2) Auriculariæ, with basidia resembling Uredineæ, but gymnocarpous, i. e., having fruit bodies which from the beginning form open hymenia; (3) Pilacreæ, which also have horizontally septate basidia, but angiocarpous or closed fruit bodies; (4) Tremellineæ, having vertically divided basidia borne in gymnocarpous fruits. The Uredineæ are especially rich in chlamydospore forms; teleutospores, uredospores, and æcidiospores are all types of this form.

The Autobasidiomycetes have undivided basidia, which bear spores only on their apex. The Hymenomycetes make up the bulk of this group and appear to have been derived from Tilletia-like forms, while the Dacryomycetaceæ have genetic relationships with the Tremellineæ, and the Gasteromycetes with the Pilacreæ, to which they are closely connected by Tylostoma. The basidia, however, in this great group are so similar that some other means of classification must be resorted to, and this is found in the fruit body. Proceeding from lower to higher, the group is divisible into (1) Dacryomycetes, with basidia split downward into two forks, but not septate; (2) Hymenomycetes, with short cylindric or club-shaped simple basidia, bearing usually 4 spores on delicate sterigmata, and having a variable but always finally gymnocarpous or only semi-angiocarpous fruit body; (3) Gasteromycetes, with basidia borne inside of various sorts of angiocarpous fruit bodies; (4) Phalloideæ, having the basidia borne during the early stages in a closed fruit body and subsequently pushed up through this and exposed to the air on a rapidly elongating sporophore.

The Dacryomycetes have also ordinary conidia and oidia. The simplest Hymenomycetes, the Tomentelleæ, are destitute of a fruit body, and the more complex forms appear to have originated from these. Next come the gymnocarpous Thelephoreæ and Clavariæ; then the hemi-angiocarpous forms, bearing the hymenium on the under surface of the pileus, on spines in Hydnei, on the walls of pores in Polyporei, and on lamellæ in Agaricineæ. The Polyporei are mostly poor in accessory fruit forms, but oidia occur in some species of Polyporus, Dædalea, and Lenzites, while Heterobasidion (*Polyporus annosus*) bears ordinary conidia, and Oligoporus and Fistulina bear chlamydospores, the former very abundantly. The genus Oligoporus was formerly described under Polyporus, and its chlamydospores were supposed to be something entirely different and were put into the form-genus Ptychogaster. In this genus Oligoporus, the formation of chlamydospores occurs in essentially the same manner as in *Chlamydomucor racemosus* or in a Ustilago. Various Agaricineæ produce sclerotia and rhizomorphs, but no ordinary conidia have been found. It must be remembered, however, that a great many forms have not been studied critically. Oidia, on the contrary, occur in many genera and are specially abundant in the genus Nyctalis. Chlamydospores are also abundant in this genus, and may occur even in the hymenial layer, but have not been discovered in other genera.

In Gasteromycetes the fruit body is not only angiocarpous in early stages, like that of many Hymenomycetes, but remains so. The simplest forms connect directly with the angiocarpous Protobasidiomycetes (Pilacreæ). Accessory fruits (oidia) are known so far only for the Nidulariaceæ. The basidiospores of most Gasteromycetes do not germinate immediately, and consequently there is a difficulty in the way of studying this group in artificial cultures. For this reason, we know them only in the mature state and in stages leading directly up to this. Pro-

ceeding from simple to complex, the Gasteromycetes are subdivided into (1) Tylostomeæ, (2) Sclerodermiæ, (3) Lycoperdiaceæ, (4) Hymeno. gastreæ, (5) Nidulariaceæ, (6) Sphæroboleæ.

The Phalloideæ constitute a highly specialized group. In all of them a hymenophorous-chambered tissue, the gleba, develops within a closed envelope, the volva, which is ruptured at maturity by the upward pressure of a rapidly elongating special sporophore, the receptacle. This bears on its surface the one-celled basidia, which in turn bear the spores at their apex on very short sterigmata. Most species are tropical and not well known. The group is divided into (1) Clathraceæ and (2) Phalloideæ.

The book is dedicated to Dr. Brefeld, and ends, as it begins, with a general discussion of the relationships of fungi and a scheme of classification, which is here reproduced.

VON TAVEL'S OUTLINE OF A NATURAL SYSTEM OF THE FUNGI.

I.—ALGA-LIKE FUNGI.

Phycomycetes, with a one-celled thallus and sexual organs.

Class I.—Oomycetes. Sexual fructification in oospores; nonsexual in sporangia and conidia.	1. Monoblepharideæ.	Antheridia and oogonia in the form of sporangia; nonsexual sporangia.
	2. Peronosporeæ. Ancylisteæ. Saprolegniaceæ. ?Chytridiaceæ.	Antheridia reduced; oogonia as sporangia; nonsexual sporangia or conidia.
	3. Entomophthoreæ.	Both antheridia and oogonia reduced; nonsexual conidia.

Class II.—Zygomycetes. Sexual fructification in zygospores; nonsexual in sporangia and conidia.	1. Exosporangia.	1. Mucorineæ. Thamnidiæ.	Sporangia only.
		2. Choanephoreæ.	Sporangia and conidia.*
		3. Chætocladiaceæ. Piptocephalideæ.	Conidia only.**
	2. Carposporangia.***	4. Rhizopeæ. Mortierellaceæ.	

II.—HIGHER FUNGI.

With septate thallus and without sexual organs.

MESOMYCETES.

(Intermediate forms connecting with the lower fungi through the Zygomycetes. Group relationships are indicated by asterisks, etc., corresponding to the termini of lines used by von Tavel.)

Class III.—Hemiasci. Fructification by sporangia and conidia; sporangia asci-like.	I. Exo-hemiasci.* †	1. Ascoideae. Protomycetes.
	II. Carpohemiasci. *** ††	2. Theleboleæ.
Class IV.—Hemibasidia. Fructification by conidia; no sporangia; conidiophores basidia-like. **	1. Ustilagineæ.†††	Conidiophores Protobasidia like.
	2. Tilletiæ. ††††	Conidiophores Autobasidia-like.

Class V.—Ascomycetes. Fructification by sporangia and conidia; sporangia determinate, i. e., asci.	I. Exoasci. † Asci free.	1.	Endomycetes. Taphrineæ.	
	II. Carpoasci. † † Asci in fruit bodies.	2.	Gymnoasci. Perisporiaceæ. Pyrenomycetes.	Angiocarpous.
		3.	Hysteriaceæ. Discomycetes. Helvellaceæ.	Hemiangiocarpous.
Class VI.—Basidiomycetes. Fructification by conidia; no sporangia; conidiophores determinate, i. e., basidia.	I. Protobasidiomycetes. † † † Basidia septate.	1.	Uredineæ. Auriculariæ.	Gymnocarpous.
		2.	Pilacreæ.§	Angiocarpous (in both groups the basidia are divided crosswise).
		3.	Tremellineæ.§ §	Basidia divided lengthwise, gymnocarpous.
	II. Autobasidiomycetes. † † † † Basidia not septate.	4.	Dacryomycetes.	Gymnocarpous. § §
		5.	Gasteromyctes. Phalloideæ.	Angiocarpous.§
		6.	Hymenomycetes.	Gymnocarpous and hemi-angiocarpous.

The book certainly deserves a wide reading, and students who are not thoroughly familiar with German will be glad to know that an authorized translation into English is now in preparation and may be expected during the year.—ERWIN F. SMITH.

WARD, H. MARSHALL. *The Diseases of Conifers.* <Jour. Royal Hort. Soc., vol. XIV, Oct., 1892. London, pp. 124–150 (in report of the conifer conference held at Chiswick Gardens, October 7 and 8, 1891).

This pleasant, popular paper discusses two classes of diseases, those due to fungi and those due to disturbing actions of the inorganic environment. The pines, firs, larches, junipers, and other conifers are taken up seriatim. Most of the facts presented have already been recorded, but for the general reader the paper has the great advantage of bringing together the scattered literature and presenting the main facts in a salient, suggestive way.

The premature shedding of pine needles is ascribed to several distinct causes: (1) Sharp frosts or nights so cold that the still tender foliage is chilled beyond recovery; (2) active transpiration when drought has removed the moisture from the soil, or in warm, sunny weather when the ground is frozen hard; (3) the action of various fungi, e. g., *Hysterium pinastri*, which is said to be one of the most prevalent and difficult to deal with.

Some general remarks on nonparasitic diseases of pines are worth quoting in full on account of their suggestiveness, but we must be content with the following:

Speaking generally, the pines require light, open, and well-drained soils, as deep as possible, and many aspects of disease are due to the nonfulfillment of these conditions.

Unquestionably one of the worst of these dangers results from clogging of the soil at the roots, whether due to wet clay, stagnant water, the covering up or hardening of the surface, e. g., by means of pavements, etc., or other processes.

The general course of events is much the same in all these cases. The primary cause of the injury is want of oxygen at the roots.

Of all the subaerial agents which damage pines, however, none are perhaps more to be feared than the acid gases of our larger manufacturing towns. Sulphurous acid, hydrochloric acid, chlorine, coal gas, and such like chemicals are fatal to pines, even in very small quantities, and it is no doubt to these rather than to the increased percentage of carbon dioxide, soot, or to the diminished light, that the foggy exhalations of large towns owe their enormous power for evil. Nor can we wonder at this when we reflect that many pines are mountain species, growing normally in those purest of atmospheres, which attract us for the very reason of their purity.

Considerable space is devoted to *Nectarina cucurbitula*, to the larch canker (*Peziza*), and to the latest views concerning Uredineous parasites. The European larch is said to be an alpine plant, and most of its diseases affecting it when under cultivation are primarily attributable to the unsuitable environment of lowland regions, especially to the earlier springs.

In this country the diseases of the larch are almost all initiated by late frosts, damp soil, insufficient sunlight, and alternations of periods of drought with periods of excessive moisture, in varying degrees of combination. Late frosts, or chills which approach such, are among the most deadly agents. The tender tufts of bright green foliage, to which the larches owe their spring beauty, are usually forced out in the country a month or six weeks too soon. Once they get well over this early dilatory period of sprouting, all is safe; their safety is insured in their mountain heights (1) by their not beginning to awake from the long winter rest till danger of frosts is practically over, and (2) by the extreme rapidity with which they run through the period of tenderness.

The germinal hyphæ of *Peziza willkomii* will not penetrate the sound cortex of the larch, but a slight frost injury or other wounds enables them to do so.

Trametes radiciperda "attacks the living roots of *Pinus sylvestris*, *P. strobus*, and others, sending its snow-white mycelium beneath the cortex, and traveling thence up the stem to finally penetrate the wood by way of the cambium and medullary rays. The rotting of the wood rapidly follows, with symptoms so peculiar that the presence of this fungus can be concluded with certainty from them." The author says that *T. radiciperda* is "now known very thoroughly from the recent magnificent researches of Brefeld,"* but cites Hartig to the effect that "moats, dug so as to cut off sound trees from infected ones, have been of service."

Agaricus melleus, though a less pronounced parasite, is not less destructive; the details of its action on the timber are different and its mode of spreading from root to root in the soil, by means of its long purple-black, cord-like mycelial strands, called *Rhizomorpha*, also differs. But the net results are much the same in both cases. Very tangible signs of the presence of *Agaricus melleus*, in the absence of the tawny yellow toadstools, are afforded by the copious outflow of resin from the diseased roots and base of the stem of the affected trees, and by the above rhizomorphs in the rotting wood and soil around.

Most of the *Polypori* mentioned are decidedly wound fungi, that is to say, they

* Brefeld's own conclusions in this connection are as follows: "Open isolation moats do not offer the least hindrance to the spread of this fungus, but, on the contrary greatly favor it, by breaking the diseased roots and inducing the formation of an unusual number of spore-bearing organs (see Untersuchungen, Heft VIII, pp. 182–184).

only attack successfully those parts of the timber which are already dead and exposed to the air; their influence for evil should not be underrated on that account, however, for although they are saprophytes living on the wood, their entrance into the trunk and branches means more or less rapid hollowing of the heart wood (thereby rendering the tree liable to be thrown by winds, etc.) and the gradual production of injurious substances which soak into the sound parts and pave the way for the advance of the destroying mycelium into living organs. Hence, though such fungi are saprophytes, strictly speaking, in their local action, they nevertheless act toward the whole tree taken as an individual as parasites which may induce dangerous diseases.

Remedial measures are, of course, to be directed to the careful tending and covering of wounds, a mode of procedure which has long been carried out on various trees at Kew and with decided success, I believe.

This last is a remark which American street and park commissioners and orchardists might well take to heart.

Prof. Ward happily avoids the fault of many popular writers. There is no effort to conceal ignorance or gloss over difficulties. At every turn the reader is informed of the present limitations of knowledge and of the necessity for further study. Concerning American fungi he writes as follows:

Farlow and Seymour give a long list of American forms [on the pine] that will necessitate much careful investigation before we can determine which are truly parasitic and which are saprophytic.

After giving Klebahn's recent conclusions, he says:

Several other forms of *Peridermium* are known on various species of pines. The following have hitherto been included with the above under the common name *P. pini*, but no one will now be so bold as to retain them until further investigations have decided as to their relationships. The forms in question occur on the cortex of *Pinus montana* (Mill.), *P. uncinula* (Ram.), *P. maritima* (Mill.), *P. polepensis* (Mill.), *P. mitis* (Mchx.), *P. laeda* (L.), *P. ponderosa* (Dougl.), *P. rigida* (Mill.), *P. insignis* (Dougl.), *P. sabineana* (Dougl.), *P. contorta* (Dougl.), and some other American pines, as well as on the leaves of the Indian *P. longifolia* (Lamb), and of the American *P. australis* (Mchx.).

Agaricus melleus is recorded by Farlow as occurring on *Chamæcyparis sphæroidea* (Spach), and the same authority mentions *Botrytis vulgaris* on Sequoia; whether these are parasitic I do not know, and in fact the whole of the very long list of conifer fungi wants careful overhauling before we can decide as to their share in producing diseases.

Finally, after calling attention to Asterina, Meliola, Coryneum, Dothidea, Pleosporæ, Sphærella, Stigmatea, etc., Prof. Ward makes the following very pertinent remarks:

With regard to a large number of these forms, and to even more numerous foreign forms, we are as yet quite in the dark as to whether they are parasites or not.

Experience warns us, however, that in many cases epidemic fungous diseases suddenly force themselves on our attention, owing to some form hitherto occurring sparsely and known only to the curious expert, having become suddenly favored in its struggle for existence. I have already given you several examples, notably that of the larch disease, into the life struggles of which we have succeeded in peering rather deeply. Surely such considerations should alone suffice to extend and cement the sympathy between the practical horticulturist and the persistent though perhaps unobtrusive investigator, which, I am happy to see, is becoming more and more pronounced as each understands better the ways and high aims of the other.—Erwin F. Smith.

ERRATA TO INDEX TO LITERATURE.

The following corrections and additions should be made in the numbers of the Index:

No. 55. *Should read*, vol. I, No. 3, May, 1890.

No. 81. *Add* (see also Texas Agr. Exp. Sta. Bull. No. 7, Austin, 1890, pp. 30, pl. 5).

No. 82. *Add* vol. VII, p. 293, 1 col.

No. 83. *Add* vol. VII, p. 259, 1 col.

No. 84. *Add* vol. VII, p. 198, figs. 4.

No. 95. *Add* pp. 235–259, figs. 8.

No. 116. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 4, 1890, p. 213, figs. 3).

No. 119. *Add* (see also Orange Judd Farmer, vol. VIII, Dec. 20, 1890, p. 387, 2 cols., figs. 6).

No. 157. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 25, 1890, p. 259).

No. 169. *Add* (see also Phila. Acad. Nat. Sci., Proc. for 1890, Part I, Jan.–Mar., 1890, pp. 36–37).

No. 214. *Should read*, Ann. Rept. Cal. State Board Hort. for 1890, Sacramento, 1890, pp. 242–249.

No. 223. Reference *should read*, Ann. Rept. Cal. State Board Hort. for 1890, Sacramento, 1890, pp. 169–177.

No. 331. *Add* (see also Exp. Sta. Bull. No. 7, Washington, 1892, pp. 101–104).

No. 357. *Add* (see also Orange Judd Farmer, vol. VIII, Oct. 11, 1890, p. 226).

No. 362. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 156–171).

No. 378. *Add* (see also Bot. Gaz., vol. XVII, Jan. 20, 1892, pp. 17–18).

No. 416. *Add* (see also Exp. Sta. Rec., vol. III, Feb., 1892, p. 445).

No. 422. *Add* p. 71.

No. 435. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 5–116, pl. 6).

No. 437. *Add* (see also Ann. de l'École Nat. d'Agr. de Montpellier, t. VI, for 1891, 1892, pp. 152–155, pl. 1).

No. 458. *Add* (see also Exp. Sta. Rec., vol. II, Apr., 1891, p. 491).

No. 459. *Add* (see also Exp. Sta. Rec., vol. III, Oct., 1891, pp. 144–145).

No. 507. *Add* (see also Exp. Sta. Rec., vol. III, Oct., 1891, p. 172).

No. 531. *Add* (see also Bull. Soc. Mycol. France, vol. VIII, Mar. 31, 1892, pp. 13–19).

No. 680. *Add* (see also Prairie Farmer, vol. LXIV, Apr. 9, 1892, p. 230).

No. 698. *Add* (see also Prairie Farmer, vol. LXIV, Aug. 20, 1892, p. 530).

No. 702. *Add* (see also Orange Judd Farmer, vol. VIII, Dec. 20, 1890, p. 387, 2 cols., figs. 6).

No. 703. *Instead of* C[HURCHILL, G. W.] *read* [BEACH, S. A.].

No. 710. *Add* (see also Gard. Chron., 3d ser., vol. X, July 18, 1891, p. 68).

No. 755. *Add* (see also Exp. Sta. Rec., vol. III, June, 1892, p. 783).

No. 780. *Add* (see also Am. Florist, vol. VI, Nov. 1, 6, 1890, pp. 150, 166).

No. 800. *Add* (see also Gard. and Forest, vol. V, Feb. 10, 1892, p. 72).

No. 876. *Add* (see also No. 531, and Bull. Soc. Mycol. France, vol. VIII, Mar. 31, 1892, pp. 13–19).

No. 885. *Add* (see also Rev. Mycol., vol. XIV, July, 1892, pp. 101–102).

No. 970. In line 18 *instead of* "referred to the following species" *read* referred to *Uromyces anthyllidis*. In line 29 *instead of* "of the latter" *read* of *U. hedysari* (DC.) Fckl."

INDEX TO LITERATURE.

In the following index all articles from foreign sources are indicated by the numbers prefixed being in bold-faced type. All those having numbers in the ordinary type relate to American literature.

A.—WORKS OF A GENERAL NATURE.

1003. [ANON.] **Potato-blight gauge.** <Ann. Rept. Sec. for Agr., Nova Scotia, for 1890, Halifax, 1891, p. 73.

Gives a table showing relation of temperature to increase of blight. There will be no blight at 30° F. Its optimum is 72°, and the blight dies at a temperature of 77° F. (J. F. J.)

1004. [ANON.] **Practice vs. theory.** <Pacific Tree and Vine, vol. IX, San José, Cal., Mar. 21, 1892, p. 5, 1 col

Refers to statement made by Mr. E. Smith at Stanford University, that Tahite orange stock is best adapted for use in California. In refuting this, quotes from W. A. Saunders to the effect that foot rot is very prevalent in Tahite stock. This writer also recommends *Citrus trifoliata* as a hardy Japanese stock, admirably adapted to resist cold, and free from disease. (J. F. J.)

1005. BAIRD, DAVID. **American Pomological Society.** <Proc. N. J. State Hort. Soc., 17th meeting, Newark, 1892, pp. 21–25.

Mentions the papers read before the meeting, referring to one by Galloway on losses from fungous diseases in 1890—from apple scab amounting to $16,000,000, and from diseases of pears, plums, etc., amounting to not less than $50,000,000 annually. Notes remarks of Erwin F. Smith on peach yellows, giving as the conclusions reached that the disease is not caused by soil exhaustion; that it can not be cured by fertilizers; that the only remedy is destruction of diseased trees; that a healthy tree can be grown where a diseased one has been; and that the disease is increasing. (J. F. J.) [The text says "can not be grown." This is an error.]

1006. BOUDIER, [E.] **Notice sur M. Roumeguère.** <Bull. Soc. Mycol. France, vol. VIII, May 22, 1892, p. 70.

Casimir Roumeguère died Feb. 29, 1892, in his sixty-third year. He was the author of a considerable number of works, some of which, especially "Revue Mycologique," secured him a great reputation. His "Cryptogamie illustrée," "Flore mycologique de Tarnet-Garonne," and finally "Fungi gallici exsiccati" occupy a prominent place in mycological literature. (T. H.)

1007. BOURQUELOT, EM. **Champignons desséchés falsifiés avec des morceaux de navet.** <Bull. Soc. Mycol. France, vol. VIII, Paris, Mar. 31, 1892, p. 39.

Alessandri (Zeitsch. f. Nahrungsm.-Untersuch. u. Hyg., 1891, p. 79) has examined some articles supposed to be dried mushrooms, but the appearance and odor did not correspond to the organisms they were said to be. They were simply turnips, cut into pieces and dried. (T. H.)

1008. BOURQUELOT, EM. **Les champignons au marché d'Iéna en 1891.** <Bull. Soc. Mycol. France, vol. VIII, Paris, Mar. 31, 1892, pp. 38–39.

Dr. Em Pfeiffer (Aufsicht des Pilzverkaufs, in Apothekerzeitung, 1891, p. 561) enumerates the mushrooms that have been offered for sale in the market of Jena. There were two varieties of *Psalliota campestris*, viz, *vaporaria* and *silvicola;* also *Marasmius scorodonius*, *Boletus edulis*, and by mistake *Boletus felleus* and *Russula fœtens*. (T. H.)

1009. COLENSO, W. **Plain and practical thoughts and notes on New Zealand botany.** <Trans. and Proc. New Zealand Inst., ser. 7, vol. XIV, Wellington, May, 1892, p. 403.

Notes that a few of the New Zealand fungi were articles of food with the ancient Maoris, but the principal edible one, *Hirneola polytricha*, has long been a commercial article, as much as 339 tons, valued at £15,581, having been collected in the forests in one year for the Chinese market. (T. H.)

1010. COOKE, M. C. **Plant diseases and fungi.** <Essex Nat., vol. VI, Essex, Jan.–Mar., 1892, pp. 18–31.

Refers to the injury caused by fungi to crops, especially cereals and apples. Notes the spread of diseases, like those of the potato and hollyhock, and mentions diseases caused by microorganisms. Peach yellows and California vine disease are especially mentioned. Refers to experiments by Halsted on cultivation of fungi, and inoculation of diseases of melons. Advocates the treatment of diseases of plants with fungicides. (J. F. J.)

1011. CONSTANTIN, JULIEN. **Note sur un cas de pneumomycose observé sur un chat.** <Bull. Soc. Mycol. France, vol VIII, May 22, 1892, pp. 57–59.

Describes some obscure organisms, consisting of large and small spores, which were found in the trachea of a cat that had died from suffocation. Two kinds of spores were found, the larger possibly belonged to a *Mortierella*, and probably represents a new species. The smaller spores may represent a species of *Mucorineæ*. (T. H.)

1012. CROOKS, WM. **Some possibilities of electricity.** <Fortnightly Rev., n. ser., vol. LI, London, Feb., 1892, pp. 173–181.

Contains a few lines about fungi. States that "electric currents not only give increased vigor to the life of higher plants, but tend to paralyze the harmful activity of parasites, animal and vegetable." Estimates the loss to Great Britain by insects and fungi at £12,000,000 per annum. Says we have yet to decide whether electricity can be made beneficial to our crops either directly or by preventing fungi. (M. B.W.)

1013. DUDLEY, W. R. **Report of the cryptogamic botanist.** <Third Ann. Rept. Cornell Univ. Agr. Exp. Sta. (for 1890), Ithaca, N. Y., 1891, pp. 29–34, fig. 1.

Describes the laboratory and the methods of work, with general mention of the work carried on during the year (see also Exp. Sta. Rec., vol. II, Apr., 1891, pp. 501–502). (J. F. J.)

1014. [EDITORIAL.] **Fruit diseases in Congress.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 19, 1892, p. 181, 1 col.

Gives text of bill introduced into House of Representatives to prohibit interstate transportation of diseased nursery stock, vines, etc. Considers the present form of the bill unwise because of difficulty of determining the presence of diseases. Believes restricting the sending of nursery stock from regions known to be affected would be a good plan, but even this has objections. Does not believe at all in the bill in its present form. (J. F. J.)

1015. [EDITORIAL.] **Get rid of the deposit.—The board of health on the grape question.** <Daily Times, New York, Sept. 27, 1891.

Gives abstracts of remarks by B. T. Galloway on the Bordeaux mixture, before the New York board of health, and the resolutions adopted by the board and the Chamber of Commerce. (J. F. J.)

1016. [EDITORIAL.] **Good news for nurserymen and fruit-growers.** <Geneva [N. Y.] Advertiser, May 5, 1891.

A statement of work to be carried on at the New York Agricultural Experiment Station, under the auspices of the Department of Agriculture, for the treatment of fungous diseases of apple, pear, quince, cherry, plum, and peach. Mentions the number of stocks and the contributors of each. Gives a summary of the problems to be investigated. Refers also to prospective treatments for apple scab at Brockport. (J. F. J.)

1017. [EDITORIAL.] **[Work on plant diseases by the Department of Agriculture.]** <Farm and Home, Wilmington, Del., May 8, 1890.

Refers to work of Division of Vegetable Pathology in investigation of peach yellows, pear leaf-blight, and scab. The two latter can be controlled by the use of fungicides. (J. F. J.)

1018. FISCHER, A. **The importation of vine cuttings to Austro-Hungary.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 8, 1891, p. 85, ⅙ col.

Notices the action of the Austro-Hungarian Government in prohibiting the importation of cuttings and even vine seeds from the United States. Considers the prohibition too sweeping. (J. F. J.)

1019. HALSTED, B. D. **What the station botanists are doing.** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Oct. 16, 1891, pp. 288–291.

A general statement of the work of botanists at 22 different agricultural experiment stations. Most of these are doing mycological work (see Exp. Sta. Bull. No. 7, U. S. Dept. of Agr., Washington, 1892, pp. 17–19, under heading of Report of the Section of Botany of the Association of American Agricultural Colleges and Experiment Stations). (J. F. J.)

1020. HARRINGTON, MARK W. **Meteorological work for agricultural institutions.** <Exp. Sta. Bull. No. 10, U. S. Dept. Agr., Washington, Feb. 3, 1892, pp. 23.

On p. 16 states desirability of making observations on the appearance of fungous diseases of plants when dependent on weather conditions. By observing these, predictions might be made as to the appearance of plant diseases. (J. F. J.)

1021. KLEBAHN, H. **Ueber Pflanzenkrankheiten und deren Bekämpfung.** Bremen, 1892, pp. 11.

A popular sketch of plant diseases and their remedies. *Peridermium strobi* seems to be dreaded in Germany, and it is recommended not to keep *Pinus strobus* in cultivation together with native or imported species of *Ribes*. No remedy is known. The author recommends the hot-water treatment as most successful against smut in the cereals, and describes this and other kinds of treatments. (T. H.)

1022. [MAYNARD, S. T.] **The amount of copper on sprayed fruit.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 38–40.

Gives a short account of analyses made of grapes and apples to ascertain the amount of copper on the fruit. On one sample of the former 0.002 of 1 per cent was found and on another no trace whatever. On one peck of apples there was 0.022 of a grain of copper, this amount requiring about 2,000 barrels of apples to yield an ounce of the copper oxide. (J. F. J.) See also *Science*, vol. XIX, May 13, 1892, pp. 275–276, under title "Is it dangerous to spray fruit trees with solutions of poisonous substances in order to prevent depredations from destructive insects?"

1023. MCALPINE, D. **Report of the vegetable pathologist.** <Dept. of Agr. Victoria, Bull. No. 12, Melbourne, July, 1891, pp. 59–60.

Gives a general outline of the work to be undertaken by the Government in investigating plant diseases. (J. F. J.)

1024. NEALE, A. T. **[Introduction to report of F. D. Chester on fungicides for grape diseases.]** <Del. Agr. Exp. Sta. Bull. No. 10, Newark, Oct., 1890, pp. 3–7.

Mentions the results obtained by treatment of vine diseases in the increased money value. Notes that leaving unsprayed rows in the center of a vineyard tends to decrease the real value of spraying. The unsprayed vines should be outside of all the good influences of the sprayed ones in order to obtain an accurate knowledge of the value of the fungicide. Notes also that anthracnose can be held in check by Bordeaux mixture and by carbonate of copper. Argues in favor of using a spray of vinegar to clear grapes of deposit of copper, should it be conspicuous (see Exp. Sta. Rec., vol. II, U. S. Dept. of Agr., Washington, July 1891, pp. 712–713.) (J. F. J.)

1025. NEALE, A. T. **[Report of the director of Delaware Agricultural Experiment Station.]** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890 [Newark], 1891, pp. 7–24, figs. 4.

Refers to the diseases of plants investigated by Prof. Chester and mentions the practical results of the work in orchards and vineyards. Mentions also investigations made on diseases of various field crops. On page 23 refers to studies on copper on grapes and in potatoes. Analyses of the former show about 47 pounds of metallic copper in 1,000,000 pounds of grapes. In potatoes the pulp showed from 1.26 to 1.33 pounds of copper per 1,000,000 pounds, while the skin showed from 16 to 40 pounds in 1,000,000 (see Chester, F. D., and Penny, C. L.). (J. F. J.)

1026. PENNY, C. L. **Report of the chemist.** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890 [Newark], 1891, pp. 129–154.

On pp. 149–150 discusses copper on grapes and concludes that it is not injurious. The tongue is as safe a guide as anything else, as with 47 parts in one million a distinctly metallic taste is perceived; this proportion is the same as that of beef liver. On p. 154 discusses the absorption of copper from the soil, and notes that potatoes absorb it to a limited degree and that it is mainly stored up in the rind of the tubers. These contain from 16 to 40 parts per million, the latter grown in a soil known to be rich in copper. (J. F. J.)

B.—DISEASES OF NONPARASITIC OR UNCERTAIN ORIGIN.

1027. [ANON.] **Peach trees with diseased branches.** <Gard. Chron., 3d ser., vol. IX, London, Apr. 14, 1891, p. 473, $\frac{1}{8}$ col.

Refers to an obscure disease due perhaps to overrich soil. Notes that knife pruning frequently causes gumming, and gives as a cure semi-starvation of roots and trimming by removing by the finger and thumb branches not wanted. (J. F. J.)

1028. [ANON.] **Peach yellows.** <Gard. and Forest, vol. IV, New York, Feb., 1891, p. 84, $\frac{1}{3}$ col.

Notes decrease of disease in Michigan, but increase in Maryland. Argues from this that benefits are likely to result from enforcement of laws against the disease. States that no cure is as yet known. (J. F. J.)

1029. [ANON.] **Peach yellows.** <Gard. Chron., 3d ser., vol. XI, London, Mar. 26, 1892, p. 402, $\frac{1}{6}$ col.

States that while the disease is unknown in England it is common in the United States. Refers to work of Dr. Erwin F. Smith, showing contagious nature of the disease. (J. F. J.)

1030. [ANON.] **"Takeall."** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, p. 182, $\frac{1}{10}$ col.; p. 186, $\frac{1}{10}$ col.

Sandy soil with clay subsoil seems to favor the disease. Caused by soil being too retentive of moisture. Insects have been observed on roots of affected plants. (J. F. J.)

1031. [ANON.] **"Take-all."** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, p. 189, $\frac{1}{10}$ col.

States that fallowed land is most subject to the disease. "Deadheads" considered a continuation of "take-all." Considerable difference of opinion was expressed in a discussion of the subject. (J. F. J.)

1032. ATKINSON, GEO. F. **Some leaf-blights of cotton.** <Ala. Exp. Sta. Bull. No. 36, Auburn, Mar., 1892, pp. 32, pl. 2.

Describes yellow leaf-blight (the same as black rust of previous papers) as a physiological disease, due to imperfect nutrition or assimilation. Gives an account of the appearance of the disease on the leaves, the injury to which may be increased by the growth of fungi under favorable conditions. Gives details of experiments with various fertilizers, especially with kainit and nitrate of soda. The former tends to prevent the disease and also to increase the crop. Gives history of kainit as a preventive, and discusses the effects of the characters of soil on the disease. "Red leaf-blight" is due to hastened maturity of the plant, caused by impoverished condition of the soil, and may be prevented by use of proper fertilizers. "Cerealite" is said to produce good results (see Exp. Sta. Rec., vol. III, July, 1892, pp. 844–845). (J. F. J.)

1033. [BERCKMANS, P. J.] **Peach rosette in the South.** <Am. Gardening, vol. XIII, New York, Dec., 1892, p. 762, $\frac{1}{3}$ col.

Notes the spread of disease in the South, as well as its virulent nature, and recommends immediate destruction of all infected trees. Wild plums in vicinity should be destroyed, as disease appears among these first and then spreads to cultivated trees. (J. F. J.)

1034. BONET, JEAN. **Folletage ou maladie nouvelle.** <Prog. Agr. et Vit., 9th year, Montpellier, July 31, 1892, pp. 97–98.

This seems to be a new disease, which has lately appeared in the French vineyards. The leaves become dry and curl up in the form of a tube, and this takes place very suddenly, while the petiole shows an annular incision at the base of the blade or where the petiole is joined to the stem. The leaves do not drop off but remain on the trees in this abnormal position. High winds may be the cause. (T. H.)

1035. BURBERRY, W. **Disease in Cattleyas.** <Gard. Chron., 3d ser., vol. XI, London, Feb. 27, 1892, p. 276, 1 col.

Describes a disease affecting orchids which causes the pseudo-bulbs and leaves to change from green to yellow and black. In one case the diseased portions were cut from the leaves and when planted recovered. The editor recommends cutting out diseased portions and washing the wound with Condy's fluid or carbolic acid. (J. F. J.)

1036. C——, G. **Tomato disease in Teneriffe.** <The Garden, vol. XXXIX, London, June 20, 1891, p. 572, $\frac{1}{8}$ col.

Refers to an obscure disease which causes plants to shrivel up on cold, clear nights, with dew but no wind. The plants recover when the weather becomes warm. (J. F. J.)

1037. CHARLTON, J. **Pruning and canker in fruit trees.** <Gard. Chron., 3d ser., vol. XI, London, Jan. 16, 1892, p. 83, $\frac{1}{8}$ col.

Records curing canker by close pruning of diseased trees. (J. F. J.)

1038. CHUARD, E. **Maladie de Californie.** <Chron. Agr. du Canton de Vaud, vol. V, Lausanne, Mar. 10, 1892, p. 116.

Refers to the destructive nature of the California vine disease and notes the demand of various societies in France that the Government prohibit the introduction of vines from California and from America in general. (J. F. J.)

1039. D——, C. W. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Jan. 14, 1892, p. 492, $\frac{1}{3}$ col.

Notes appearance of disease on certain varieties of violets. Remedy consists in picking off affected leaves. (J. F. J.)

1040. DEGRULLY, L. **Les Tétranyques et la brunissure.** <Prog. Agr. et Vit., 9th year, Montpellier, Aug. 21, 1892, pp. 169–170.

F. Sahut claims to have discovered a new disease of grapevine, due to insects. These are red spiders (*Tetranychus*), which live upon the lower surface of the leaves, where they produce a silky tissue, rather loose in texture. The leaves attacked in this way turned yellow, faded, and soon dropped off. Viala considers this case to be a mere coincidence, since, according to him, the leaves were killed by *Plasmodiophora vitis*, although the color of the spots on the leaves was bright red, not brown, as in the "brunissure." Several correspondents state that this disease seems to start in places near the roads, where it often has been observed to remain without going farther. (T. H.)

1041. DOD, C. W. **Basal rot in daffodils.** <Gard. Chron., 3d ser., vol. X, London, Aug. 8, 1891, p. 173, $\frac{1}{4}$ col.

Notes the presence of an obscure disease in bulbs, due, it is thought, to impaired constitutions arising from unsuitable cultural conditions. (J. F. J.)

1042. GAYLORD, EDSON. **Pruning orchard trees.** <Orange Judd Farmer, vol. XI, Chicago, Feb. 27, 1892, p. 133, $\frac{2}{3}$ col.

Argues against too great trimming of fruit trees in the Northwest, as it renders them liable to be killed by the hot sun [sun scald]. (J. F. J.)

1043. H——, T. C. **Splitting of peaches and nectarines.** < Gard. Chron., 3d ser., vol. x, London, Oct. 24, 1891, p. 493, ⅓ col.

Attributes this trouble to conditions of moisture and heat. (M. B. W.)

1044. HAMANN, VALENTINE. **Violets.** < Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 461, ⅓ col.

States belief that disease is due to planting out late and to the plants being grown too delicately. (J. F. J.)

1045. HELLIER, J. B. **Peach yellows again.** < Agr. Jour. Cape Colony, vol. IV, Cape Town, Dec. 17, 1891, p. 135, ⅔ col.

Refers to the article in Scientific American (see No. 366), stating that the disease is due to starvation. Does not so regard it, but believes lowered vitality may make the tree more susceptible to the disease, hence recommends the use of potash fertilizers, especially wood ashes, to keep fruit trees in good condition. (J. F. J.)

1046. HEYER, EDUARD. **Eine neue Krankheit der Eichenschälwaldungen.** < Allgemeine Forst- und Jagdzeitung, Darmstadt, Dec., 1891, pp. 438–439.

A supposed new disease has appeared upon oak trees 2 years old in plantations near Alzey, in Rhein-Hessen. The leaves show curled margins and soon fade away, and the branches die soon after. In this manner numerous trees have been destroyed, but the nature of the disease is not known. Prof. Hartig supposes that the disease is due to a fungus, the mycelium of which he claims to have discovered, but not yet described. (T. H.)

1047. HOPTON, E. **The cultivation of the peach (Persica vulgaris).** < Dept. of Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 134–137.

Notes the occurrence of "yellows" in Victoria. States that he believes it was stamped out of his orchard by digging away the old and substituting fresh soil. Does not know any cure and recommends the removal of the tree when the disease has attacked it. For "curl blight" recommends, when the tree is coming into leaf, clearing the earth from the collar of the tree and watering with 1 pint of coal tar to 6 gallons of water, repeating the same when the fruit is set. (J. F. J.)

1048. LELONG, B. M. **Eastern peach yellows.** < Ann. Rept. State Board Hort. of Cal. for 1891, Sacramento, 1892, pp. 405–410, fig. 1.

Gives a statement of the wide extent and destructive character of the disease, advocates prohibiting the importation of trees from outside the State, and advises against buying trees from localities outside of California. (J. F. J.)

1049. MACOWAN, P. **Disease in peach trees.** < Agr. Jour. Cape Colony, vol. III, Cape Town, May 7, 1891, p. 201, ⅓ col.

Asks peach-growers whose trees are affected by "chlorosis of the leaves, supposed to be the same disease as the American yellows," to try the effect of mixing sulphate of iron with the soil about the trunk of the trees. (J. F. J.)

1050. MACOWAN, P. **Peach yellows again.** < Agr. Jour. Cape Colony, vol. IV, Cape Town, Dec. 17, 1891, p. 135, ⅔ col.

Refers to work of Dr. Erwin F. Smith, and to the statement of Meehan that *Agaricus melleus* is the cause of the disease. Quotes Sargent against this theory and argues against it himself, arguing in favor of a bacillus being the cause. Mentions a disease of the olive produced by a similar organism, and one of young blue-gum trees. Recommends the immediate destruction of the latter by fire. (J. F. J.)

1051. MACOWAN, P. **Yellows in peach trees.** < Agr. Jour. Cape Colony, vol. III, Cape Town, May 7, 1891, p. 208, ½ col.

Refers to an article in Garden and Forest to the effect that the disease in New Jersey is caused by a species of root louse and may be cured by the application of kainit or tobacco. Questions this assertion and notes that examinations of trees in South Africa have failed to reveal any insect or insect injuries. (J. F. J.)

1052. MEEHAN, THOS. **Peach tree "yellows."** < Meehan's Monthly, vol. II, Germantown, Pa., May, 1892, p. 80, ½ col.

Notes the fact that while peach trees have been shipped in large quantities to the South and to the Pacific coast from the Northeastern States, yellows has not appeared in either locality. Yet as soon as they were sent to Michigan and some other States the disease appeared. Queries why this should be, and refers to reasons suggested in a previous number of the Monthly (see No. 679) [i. e., because the disease is due to *Agaricus melleus*, which does not occur where the disease is absent]. (J. F. J.)

1053. MEIER, HERMANN. **Yellows in peach trees and disease in hop plants.** < Agr. Jour. Cape Colony, vol. IV, Cape Town, Nov. 5, 1891, p. 105, ⅔ col.

Notes the occurrence of what may be yellows and asks for information. States also that rust had appeared on hop plants. (J. F. J.)

1054. PECK, D. E. **Fruit tree sun-scald.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 12, 1892, p. 164, ⅓ col.

Argues against excessive trimming of fruit trees in the Northwest, as the hot afternoon sun is liable to produce sun-scald if the top be too open. (J. F. J.)

1055. PERINGUEY, L. **Disease in orange trees.** <Agr. Jour. Cape Colony, Cape Town, Apr. 23, 1891, pp. 192–194.

Describes a disease in which the leaves become yellow, a gum exudes from the bark above the ground, and the roots when exposed give out an offensive smell. The trouble occurs in all situations, and is supposed to be due to a fungous parasite. (J. F. J.)

1056. ROBINSON, NORMAN. **The "die-back" question again.** <Fla. Disp. Farm. and Fruit Grower, n. ser., vol. IV, Jacksonville, May 5, 1892, pp. 352–353.

Considers the disease in the greater number of cases due to "ill-balanced or defective fertilization." Gives analyses of various kinds of soil, and thinks that in one case at least the cause of the disease was defective drainage of the subsoil. Believes that the application of lime to the surface and good drainage below the surface will be beneficial. (J. F. J.)

1057. TAYLER, WILL. **Cracks and spots on pears.** <Gard. Chron., 3d ser., vol. XI, Feb. 6, 1892, London, p. 180, ½ col.

Thinks that climatic influences, such as an east wind, are the most important causes of diseases of plants. In case of the pear, states that the strongest predisposing cause is a crude, infertile subsoil. In a note by the editor the appearance of injuries caused by *Fusicladium* and *Gymnosporangium* are briefly described. (M. B. W.)

1058. TEPPER, J. G. O. **"Take-all," and its remedies.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Jan , 1892, pp. 69–72.

Describes the appearance of a field affected by the disease, and notes that it has been variously ascribed to fungi, insects, frost, inefficient fertilization, etc. Sketches the general needs of plants for growth, and concludes that the disease is due to starvation. Gives instances where manuring or fertilizing had prevented it, and advocates use of manure for its prevention. (J. F. J.)

1059. VAN DEMAN, H. S. **The relative merit of various stocks for the orange.** <Div. of Pomol. Bull. No. 4, U. S. Dept. Agr., Washington, 1891, pp. 1–17.

Notes that sour stock is generally free from disease, especially *Mal di goma*, and recommends the grafting of budded stock on it rather than on sweet. Sour seedlings are affected by leaf-scab, but when budded the danger from this is over, as the disease does not affect the sweet top. Ammoniacal solution of copper recommended for trial. *Mal di goma* occurs in Louisiana among sweet seedlings, and is there known as "sore shin." In California it has been treated by cutting out diseased wood and painting with rubber paint. Sour stock is used there also. For a reprint of the article, together with notes on *Mal di goma*, by W. R. King see No. 353; also Agr. Gaz. N. S. Wales, vol. III. Sydney, Feb., 1892, pp. 129–141. (J. F. J.)

1060. [VARIOUS.] **Black-knot.** <Ann. Rept. State Board Hort. of Cal. for 1891, Sacramento, 1892, pp. 431–432.

A discussion on black-knot of roots of nursery stock and grapevines, some stating the cause to be moisture, others that the trouble is due to the stagnation of sap or bursting of sap vessels. (J. F. J.)

(See also Nos. 1005, 1010, 1068, 1108, 1212.)

C.—DISEASES DUE TO FUNGI, BACTERIA, AND MYXOMYCETES.

I.—RELATIONS OF HOST AND PARASITE.

1061. BURRILL, T. J. **What are the possibilities of originating a class of pears exempt from blight?** <Proc. Am. Pom. Soc. for 1891, 23d session, 1891, pp. 66–70.

Notes the cause of blight to be a microorganism (*Micrococcus amylovorus*) and describes its general appearance and mode of growth. Believes it possible to overcome blight, and suggests testing the ability of different varieties of pears to resist blight by inoculation. (J. F. J.)

1062. C[OOKE], M. C. **Fungi on various trees.** <Gard. Chron., 3d ser., vol. IX, London, Jan. 24, 1891, p. 123, ⅓ col.

Notes that various species of Polyporei occurring on trees attack only decayed places, and not the living, healthy tissues. (J. F. J.)

1063. HALSTED, B. D. **Parasitic fungi as related to variegated plants.** <Bull. Torrey Bot. Club, vol. XIX, New York, Mar. 5, 1892, pp. 84–88.

Notes the fact that plants with variegated leaves seem more subject to the attacks of fungi than those not variegated. Gives a list of the genera of plants containing species with variegated leaves and the genera attacking each. Notes that the more widely the light spots are scattered over the leaf, the more generally the leaf is diseased. Considers it natural for variegated plants to blight, inasmuch as they are deprived of a large part of the necessary chlorophyll and are in a weakened condition in consequence (see notice in Science, vol. XIX, Mar. 25, 1892, p. 172, ½ col; also Gard. and Forest, vol. V, Mar. 23, 1892, p. 142, where the paper is reviewed and an argument advanced against the use of variegated plants as ornamental features in landscape gardening). (J. F. J.)

1064. HALSTED, B. D. **The influence upon crops of neighboring wild plants.** <Proc. N. J. State Hort. Soc., 17th meeting, Newark, 1892, pp. 110–122 (reprint 13 pp.).

Shows the interrelations between wild and cultivated plants, especially as regards the effects of fungi upon such crops as lettuce, celery, spinach, etc. Insists upon the necessity of keeping the plants healthy by proper cultivation, seeding, etc. If this be done, and then a fungicide used, its effect will be most marked (see Bot. Gaz. Apr., 1892, vol. XVII, pp. 113-118, under the title "Some fungi common to wild and cultivated plants," with a few changes in phraseology. An extract also given in Science, vol. XIX, Apr.29, 1892, p. 243, ½ col). (J. F. J.)

(See also No. 1223.)

II.—DISEASES OF FIELD AND GARDEN CROPS.

1065. [ANON.] **Lettuce mildew.** <Gard. Chron., 3d ser., vol. XI, London, Apr. 23, 1892, p. 534–535, ⅙ col.

Notes occurrence of *Bremia lactucæ* in market gardens near London and quotes from W. G. Smith remedy for same. (J. F. J.)

1066. [ANON.] **Potato disease.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Jan., 1892, p. 77.

Gives a statement of the general method of cultivating the potato and says that the disease caused by *Phytophthora infestans* is not known in New South Wales. (J. F. J.)

1067. ARTHUR, J. C., and GOLDEN, K. E. **Diseases of the sugar-beet root.** <Purdue Univ. (Indiana) Agr. Exp. Sta. Bull. No. 39, vol. III, La Fayette, Apr. 13, 1892, pp. 55–62.

Describe a disease due to a bacterial parasite which affects in a marked degree the percentage of sugar derived from the beets. Beet scab, caused by *Oospora scabies* Thax., also described and illustrated. This disease originates from the soil and is caused by the spores lying there, derived from some previous root crop. Water core spots, the origin of which is unknown, also described (see Gard. Chron., London, June 4, 1892, p. 726; Exp. Sta. Rec., vol. III, July 1892, pp. 853–855; Agr. Sci., vol. VI., Aug. 1892, pp. 383–384; Gard. and Forest, vol. V, Apr. 27, 1892, p. 204). (J. F. J.)

1068. BAILEY, L. H. **Some troubles of winter tomatoes.** <Cornell Univ. Agr. Exp. Sta. Bull. No. 43, Ithaca, N. Y., Sept., 1892, pp. 149–158, figs. 4.

Describes "winter blight" of tomatoes, a disease affecting plants in the forcing houses. This attacks the leaves and sometimes kills the plants outright. Probably caused by bacteria, but is different from the bacterial disease of potatoes. No remedy yet known, but it is recommended to remove all diseased plants as soon as observed. If disease becomes very severe both plants and soil should be removed and a new start made. Common blight, caused by *Cladosporium fulvum*, also described. Spraying with ammoniacal carbonate of copper is recommended. Roots of plants are also attacked by nematode root galls. (J. F. J.)

1069. BEHRENS, I. **Ueber das Auftreten des Hanfkrebses im Elsass.** <Zeitsch. Pflanzenkrank., vol. I, Stuttgart, 1891, pp. 208–215.

Two fungi have been observed injuring hemp in Elsass, namely, a *Sclerotinia*, the species of which could not be ascertained, but seemed to be either *fuckeliana* or *libertiana*, and *Melanospora cannabis* sp. nov. The author examined two crops from 1890 and 1891, and several stems from the first year's collection showed the presence of *Botrytis*. No *Botrytis*, however, was observed on material of the following year's crop, although the stems showed numerous hyphæ of a fungus like those from the preceding year. By transferring this fungus upon bread, sclerotia developed very abundantly, but no *Botrytis*. The fungus proved to be a *Sclerotinia*, of which the species *libertiana* is well distinguished from *fuckeliana* by not having the *Botrytis* fructification during the mycelial stage. Further studies are necessary for the specific identification of this fungus. *Melanospora cannabis* is red and occurs upon the base of the stems of hemp. It not only flourishes upon the hemp, but also upon the resting stage of *Sclerotinia*, which it destroys entirely. (T. H.)

1070. Bos, J. Ritzema. **De klaverkanker, eene zich meer en meer uitbreidende klaverziekte.** <Wageningen, May 16, 1892, pp. 13.

Contains a general sketch of the canker, which affects *Trifolium pratense* especially, due to *Sclerotinia trifoliorum*. Besides a description of the life history of this fungus, the author gives some statements as to the eradication of the disease, and recommends digging out the infested parts of the clover field and burning the plants in a pit which has been partly filled with quicklime. The disease has been observed in several places in Holland, especially in Gröningen, Zeeland, and North Brabant. (T. H.)

1071. Cobb, N. A. **Notes on the diseases of plants.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Oct., 1891, pp. 616–624, pl. 2, figs. 5.

Gives notes on diseases of plants, as follows: Onion mildew, caused by *Peronospora schleideniana*, and for which Bordeaux mixture is recommended; tobacco mildew, caused by *Peronospora hyoscyami*; potato blight, murrain, or rot, caused by *Phytophthora infestans*, although not yet known in the colony, is fully described so that it may be known if it should appear. Bordeaux mixture is given as one preventive, clean culture and high molding being others; and banana disease, the cause of which is unknown, but may be due to a fungus attacking the roots. Mention is also made of the occurrence of bread mold on oranges, supposed to be caused by injury to the fruit. (For portion relating to diseased banana plants, see Bull. Bot. Dept. Jamaica, No. 31, May, 1892, p. 2; also, under title of "Banana disease in Fiji," Bull. Miscel. Infor. Royal Gard. Kew, No. 62, Feb., 1892, pp. 48–49.) (J. F. J.)

1072. Cobb, N. A. **Smut.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Nov., 1891, pp. 672–677, figs. 4.

Describes the various forms of smut of cereals; caused in oats by *Ustilago avenæ;* in wheat by *U. tritici*, *Urocystis occulta*, and *Tilletia fœtens;* also describes smut in maize. Gives various methods of treatment, mainly hot water and "bluestone." These last are recommended for all the smuts. (J. F. J.)

1073. C[ockrell], T. D. A. **The new coffee disease.** <Notes from Mus. Inst. Jamaica, No. 27 [Kingston], Oct. 29, 1892, p. 1.

Refers to disease of fungous origin affecting leaves of coffee. In appearance the disease resembles potato rot. The name of the fungus was not determined. (J. F. J.)

1074. C[ockrell], T. D. A. **The sugar-cane fungus.** <Notes from Mus. Inst. Jamaica, No. 18 [Kingston], July 23, 1892, p. 1.

States that specimens sent from Trinidad affecting sugar cane belong to a species to be described as *Trullula sacchari* Ell. & Ev. Says also that a bacterial disease may be present, but of this there is as yet no absolute proof. (J. F. J.)

1075. C[ooke], M. C. **Tobacco disease.** <Gard. Chron., 3d ser., vol. IX, London, Feb. 7, 1891, p. 173, ⅔ col.

Notes the occurrence of *Peronospora hyoscyami* in Australia, where it attacks tobacco leaves. Describes the appearance of the fungus, and suggests burning all diseased plants. Does not believe spraying with fungicides would be of any benefit in checking the disease. (J. F. J.)

1076. Detmers, Freda. **[Fungus on Lactuca.]** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 145–146, figs. 3.

Describes general appearance of *Septoria consimilis*, introduced from *Lactuca scariola* to cultivated lettuce. (J. F. J.)

1077. Detmers, Freda. **Scab of wheat.** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 147–149, figs. 2.

Describes appearance and mode of attack of *Fusisporium culmorum* W. Sm., causing wheat scab (see Am. Agr., vol. LI, Dec., 1892, p. 756). (J. F. J.)

1078. Halsted, B. D. **Anthracnose in bean seeds.** <Gard. and Forest, vol. V, New York, Jan. 13, 1892, p. 18, ¾ col.

States the disease is caused by *Colletotrichum lindemuthianum*. Describes general appearance of affected seed, and says that those showing disease did not germinate as well as healthy seed, and the plants were diseased. Advocates soaking seed in solution of 3 ounces of carbonate of copper, 1 quart of ammonia water, and 4½ gallons of water. (J. F. J.)

1079. Halsted, B. D. **Some fungous diseases of the celery.** <N. J. Agr. Exp. Sta. Special Bull. Q, New Brunswick, Apr. 21, 1892, pp. 12, figs. 14.

Describes celery blight or "rust" as caused by *Cercospora apii*, giving an account of successful treatment with ammoniacal copper carbonate solution; celery leaf-spot due to *Phyllosticta apii* n. sp; another leaf-blight, due to *Septoria petroselini* var. *apii;* celery rust proper, due to *Puccinia bullata*; and a bacterial disease of celery that attacks and destroys the hearts of the plants. It is thought that ammoniacal copper carbonate solution can be successfully used for all three diseases (see also Am. Agr., July, 1892, vol. LI, pp. 426–427; Exp. Sta. Rec., vol. III, July, 1892, pp. 884–885). (J. F. J.)

1080. HUMPHREY, J. E. **The powdery mildew of the cucumber (Erysiphe cichoracearum DC.)** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 222–226.

Describes the appearance and development of the disease. Recommends as a preventive a solution of sulphide of potassium (liver of sulphur), 1 ounce to 4 gallons of water. Stronger solutions injure the leaves. Ammoniacal carbonate of copper solution also effective, but vapor of sulphur better than either, care being taken not to have the sulphur burn (see No. 394). (J. F. J.)

1081. HUMPHREY, J. E. **The rotting of lettuce (Botrytis vulgaris, Fr.).** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 219–222.

Describes the disease as due to *Botrytis*, possibly *B. vulgaris*, and traces its development. Considers *B. vulgaris* to be the conidial stage of some Sclerotium-producing *Peziza*. Recommends clean culture and keeping plants in a healthy condition as best preventives (see No. 394). (J. F. J.)

1082. HUMPHREY, J. E. **Various diseases [of potato, etc.].** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 226–235.

Preliminary notes on diseases of the following plants: Potato, caused by a species of *Macrosporium;* cucumber, caused by *Acremonium* (?) sp.; rye, caused by *Urocystis occulata* Wallr., and also by *Puccinia rubigo-vera* (DC.) Wint.; cabbage, caused by *Plasmodiophora brassicæ* Wor.; celery, caused by a species of *Cercospora* or *Septoria*, probably that described by Chester as *S. petroselini* var. *apii*, occurring in Delaware; clover, caused by *Uromyces trifolii* and *Polythrincium trifolii* Kze.; fish eggs, caused by *Achlya racemosa* Hild.; black poplar, caused by *Melampsora populina* (Jacq.) Lév.; chestnut, caused by *Marsonia ochroleuca* (B. & C.); also plum and tobacco diseases. (J. F. J.)

1083. JONES, L. R. **Plant diseases.** <Vt. Agr. Exp. Sta. Bull. No. 28, Burlington, Apr., 1892, pp. 15–36, fig. 1.

The following diseases are discussed: (1) Potato blight and rot; this was successfully treated by the use of Bordeaux mixture; the question whether it will pay to spray is answered in the affirmative; the expense of spraying and method of making and applying the mixture are given. (2) A new potato disease, differing in various respects from the ordinary blight, and thought to be possibly due to bacteria. (3) Potato scab, which is described mainly from the North Dakota Agr. Exp. Sta. Bull. No. 4 (see No. 382). (4) Apple and pear scab, both of which were successfully treated, ammoniacal copper carbonate solution being preferred to Bordeaux mixture, as it does not injure the foliage and is cheaper; directions are given for making and applying the fungicides. (5) Oat smut, which can be prevented by the Jensen hot-water treatment, and for which directions are given (see Exp. Sta. Rec., vol. III, July, 1892, pp. 891–892). (J. F. J.)

1084. KERR, CHAS. **Diseases of eggplants.** <Fla. Disp. Farm and Fruit Grower, n. ser., vol. IV, Jacksonville, Apr. 21, 1892, p. 307, ½ col.

Notes the "falling" of eggplants as due to *Pythium debaryanum*. Considers the "falling" the same as "damping off," and gives only remedy known to him as plenty of light and air and not too much moisture. (J. F. J.)

1085. MCALPINE, D. **Vegetable pathology.** <Dept. of Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 21–50, pl. 3.

Gives more or less complete accounts of the following diseases: (1) Rust of wheat, describing its cause and life history, and giving a list of host plants; it is due to *Puccinia graminis*. (2) Wheat blight, due to *Septoria tritici*. (3) Club-root of cauliflowers, cabbages, etc., due to *Plasmodiophora brassicæ*, mentioning the conditions favoring the disease and giving a sketch of the life history of the fungus. (4) Beet leaf rust, caused by *Uromyces betæ*. (5) Raspberry root fungus, the cause of which is stated to be *Rhizomorpha*. (6) Root-gall disease of cucumbers, due to a nematode worm. The descriptions of the diseases are accompanied by notes on remedies. (J. F. J.)

1086. LAMSON-SCRIBNER, F. **The fungous diseases of plants.** <Proc. 16th Ann. Meeting East Tennessee Farmers' Convention, May 19 and 20, 1891, Nashville, 1891, pp. 16–25.

An address concerning various fungous diseases, and treating of smuts of corn, oats, and wheat; mildew of potato; potato rot and scab; rusts of wheat, corn, apple, and blackberry; and pear blight. Gives remedies for most of these, and discusses liquid and powder fungicides, with means of applying remedies, and mention of good results ensuing. Issued as a separate under title of "Address on the fungous diseases of plants," Nashville, 1891, 16°, pp. 31. (J. F. J.)

1087. SPEER, R. P. **Our rusted and blighted wheat, oats, and barley in 1890.** <Iowa Agr. Exp. Sta. Bull. No. 10 [Ames], Aug., 1890, pp. 391–400.

Refers to the fact that many kinds of oats, wheat, and barley are invariably injured by rust, and gives details of experiments. Mentions varieties planted, and notes that all varieties except Mansbury barley were badly rusted, most of them so badly as not to be worth harvesting. Discusses the change in climate due to the cultivation of the prairies in the State and shows the relation between climate and attacks of rust. States that cereals are never injured by rust where there are no great extremes of summer temperature and no severe spells of drought. Advocates sowing of clover to regenerate the land, and gives

1087. SPEER, R. P.—Continued.

as the result of observation and experiment the following: (1) If oats continue to be grown they should be sown as early in the spring as possible, and only such varieties as the Everett or improved American should be used; (2) of barleys the most valuable is the Manshury, which should be sown early and raised in preference to oats of any variety; (3) all varieties of spring wheat are unreliable and should be discarded. The best varieties of winter wheat tested were Turkish and Golden Cross (see also Exp. Sta. Rec., vol. II, Dec., 1890, pp. 213–215). (J. F. J.)

1088. STURGIS, W. C. **Preliminary report on the so-called "pole-burn" of tobacco.** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 168–184.

Discusses the origin of the disease, due to a fungus, and caused by hanging the tobacco so close as to prevent free circulation of air, and by the presence of moisture, due to fogs, dew, etc. Describes the effects of the disease, and states it is due to a species of *Cladosporium*, which, by partially destroying the tissues of the leaf, gives access to bacteria. Describes methods of culture and gives remedies; the latter are, better ventilation and improved methods of curing, mainly by artificial heat (see Exp. Sta. Rec., vol. III, June, 1892, pp 773–775). (J. F. J.)

1089. STURGIS, W. C. **Stem-rot [of tobacco].** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 184–186.

Describes appearance of disease and states that it is due to a fungus referred provisionally to the genus *Botrytis*. Gives brief sketch of life history and names it *B. longibrachiata*. As remedies, recommends cleanliness, burning all diseased stems and leaves, and having the barn floor sprinkled with air-slaked lime and sulphur. If floor be of earth, cover with clean, dry earth to depth of 1 inch. Fumigation by burning sulphur also recommended (see Exp. Sta. Rec., vol. III, June, 1892, pp. 775–777). (J. F. J.)

1090. THAXTER, R. **Potato scab.** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 153–160.

Reviews work of Bolley, Arthur, and himself on the disease, and quotes from Bolley as to the identity of surface and deep scab (see No. 382). Gives details of experiments in planting scabby tubers, and concludes that application of fungicides to plants is useless. Recommends (1) use of seed free from scab; (2) not to plant on land which has produced diseased crops of potatoes or beets or has been fertilized with manure from stock fed with scabby potatoes; (3) not to feed scabby tubers to stock without cooking; (4) fertilize with other materials than barnyard manure; (5) dig potatoes as soon as possible after maturity. Describes fungus producing the disease under name of *Oöspora scabies*, n. sp., and discusses its position in classification (see Nos. 238 and 311; also Exp. Sta. Rec., vol. III, June, 1892, pp. 771–772). (J. F. J.)

1091. TRACY, S. M. **Cooperative branch stations in the South.** <Rept. Sec. of Agr. for 1891, Washington, 1892, pp. 5–12 (reprint).

On p. 8 notes that *Puccinia coronata* attacks and kills *Holcus lanatus* when about ready to bloom. (J. F. J.)

1092. WINDMILLER, FR. **How to prevent tomato rot.** <Am. Gardening, vol. XIII, New York, Apr., 1892, p. 221, ⅔ col.

Gives experience in planting tomatoes for two years in succession on same ground, and concludes it is necessary to plant crop on new ground each year if rot is to be prevented. (J. F. J.)

(See also Nos. 1053, 1105, 1107, 1108, 1172, 1192, 1196, 1204.)

III.—DISEASES OF FRUITS.

1093. [ANON.] **Apple scab (Fusicladium dendriticum).** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 27–29.

Notes the receipt of strongly developed specimens of this fungus on leaves of the apple from different parts of the country [Great Britain] and a profusion of samples from Australia. The recommendations for treatment by spraying with fungicides are quoted from the U. S. Department of Agriculture Reports (see Gard. Chron., 3d ser., vol. X, Nov. 14, 1891, p. 580). (M. B. W.)

1094. [ANON.]. **Bladder plums.** <Gard. Chron., 3d ser., vol. IX, London, May 30, 1891, pp. 672–673, figs. 2.

Notes the disease to be due to *Taphrina* or *Exoascus pruni* and states a close connection exists between it and *Exoascus deformans* causing peach blister. (J. F. J.)

1095. [ANON.] **Citron culture in Corsica.** <Gard. Chron., 3d ser., vol. XI, London, Jan. 30 and Feb. 6, 1892, pp. 149–150, 182–183.

In noticing a report of the British Consul at Ajaccio, refers to diseases affecting the tree. "White-root" is the worst. Due to a fungus attacking the cortical tissue of the root. Describes appearance. Recommends, (1) pruning to the quick all roots deprived of vitality and apportioning branches to correspond to root system, and then surrounding tree with deep trench with a free passage for overflow of water; (2) pruning affected roots and applying

1095. [ANON.]—Continued.

tar to cut ends (this gives best results): (3) aeration of roots, exposing them and filling in space with stones or charcoal and filling up about trunk of tree 15 inches above surface of ground. *Fumagine* (smut or citron black) also described. Destroyed by whitewashing tree as far as bark extends and spraying the leaves. Tobacco juice and soft-soap spray also gives good results. The branches should also be trimmed out so as to allow air to circulate freely. (J. F. J.)

1096. [ANON.] **Raspberry anthracnose.** <Am. Gardening, vol. XIII, New York, Apr., 1892, p. 239, ½ col.

Describes the disease and recommends plenty of air and sunlight between the canes. Before buds start, spray with sulphate of iron (2 pounds in 5 gallons of water); and if it appears later use Bordeaux mixture. Burn badly diseased canes. (J. F. J.)

1097. [ANON.] **The filbert fungus.** <Am. Agr., vol. LI, New York, Dec., 1892, p. 755, ⅙ col.

States that as the fungus affecting filberts has not yet been discovered, there is no method to be recommended to check it. It resembles black knot of plum and cherry, but probably belongs to a different genus. It is destructive to foreign varieties, but does not seem as yet to have attacked natives. (J. F. J.)

1098. ATKINS, JR., E. [**Peach-rust and fire-blight.**] <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes the occurrence of the diseases at Ermington, and says lime will prevent the former. (J. F. J.)

1099. BAILEY, L. H. [**Fruit spot of plum.**] <Cornell Univ. Agr. Exp. Sta. Bull. No. 38, Ithaca, N. Y., June, 1892, p. 56, fig. 1.

Notes disease affecting the fruit, referred by Humphrey to a species of *Phoma*. (J. F. J.)

1100. "BEDFORD FARMER." **Fungous disease in orange trees.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Nov. 19, 1891, p. 118, ⅜ col.

Describes a disease affecting the bark of orange twigs. Ashes and sulphur applied to stem of tree said to stop the disease. Supposed to be spread from tree to tree by water used in irrigating. (J. F. J.)

1101. BEINLING, E. **Ueber das Auftreten von Rebenkrankheiten im Grossherzogtum Baden im Jahre 1891.** <Zeitsch. Pflanzenkrank., vol. II, Stuttgart, 1892, pp. 207–210.

The vine diseases in Baden in 1891 were especially mildew, black rot, and the so-called false mildew, due to *Peronospora viticola*. *Sphaceloma ampelinum*, the well-known anthracnose, has not been observed. Root mold, due to *Dematophora necatrix*, is, on the other hand, widespread and seems to increase every year. (T. H.)

1102. BESSEY, C. E. **The smut of Indian corn.** <Ohio Agr. Exp. Sta. Bull. No. 10, vol. III, 2d ser., Columbus, Nov., 1890, pp. 264–272, figs. 2.

Describes the general appearance of the disease and its wide prevalence. Opinions differ as to its effect on cattle, as shown by letters quoted. Describes the structure and growth of the spores, and discusses the question of how to reduce the quantity of smut. Clean cultivation, rotation of crops, destruction of infected plants, and use of clean seed are all said to have influence in reducing the amount. (J. F. J.)

1103. BRIDLE. [**Windsor pear-blight.**] <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney Feb., 1891, p. 25.

States that disease is overcome to a certain extent by grafting the Windsor on another stock. (J. F. J.)

1104. BRUNK, T. L. **Pear stocks.** <Tex. Agr. Exp. Sta. Bull. No. 9, College Station, May, 1890, pp. 5–22, figs. 7.

Refers to susceptibility of certain varieties of pears to blight, stating that Le Conte and Kieffer are less subject to the disease on well drained soils in the Gulf States on their own roots than on French stock. Root rot of pears seems to be caused by *Ozonium auricomum*, which also affects cotton and other plants. Describes the effects of the disease in pear trees. (J. F. J.)

1105. CHESTER, F. D. **Report of the mycologist.** <Third Ann. Rept. Del. Agr. Exp. Sta. for 1890, Newark, 1891, pp. 45–91, figs. 15.

Gives details of experiments in various vineyards to prevent black rot and anthracnose. Tables of the product of the vines and statements of the money value of the sprayings are given. In a general way the experiments point to Bordeaux mixture as the best fungicide with which to treat badly infected vineyards, but when the disease has been brought under control after one or two seasons' work, carbonate of copper and carbonate of ammonia mixture is equally as effective and less expensive. Bordeaux mixture, while acting as a fungicide, possesses the additional advantage of stimulating the growth of the vines. It also controls anthracnose. An experiment in bagging grapes is also described, several periods of infection being mentioned. These seem dependent upon weather conditions. Directions are given for

1105. CHESTER, F. D.—Continued.

preparing and applying the various fungicides used, and the spraying apparatus necessary is described. In experiments upon pear and quince leaf-blight, it was found that modified eau céleste, and carbonate of copper and carbonate of ammonia mixture gave the best results and were the two cheapest fungicides employed. An experiment with potato rot (*Phytophthora infestans*) is described, and Bordeaux mixture is noted as effectually controlling the disease. Bitter rot of the apple was experimented with, and sulphide of potassium gave fairly good results when used in the proportion of one-half ounce per gallon of water. Gives the results of a study of leaf spot of alfalfa produced by *Pseudopeziza medicaginis*, describing characters and life history as shown by artificial cultures. Rot of scarlet clover caused by *Sclerotinia trifolium* also described and its life history discussed. Scab of wheat caused by *Fusarum culmorum* described. Black rot of sweet potato (*Ceratocystis fimbriata*) was experimented with, and it was found that diseased soil will produce the disease even in healthy roots, that the soil can be rendered free of germs by sterilization or heat, and that plants grown from diseased tubers will probably become diseased. (J. F. J.)

1106. COBB [N. A.]. [**Fungous diseases of fruit trees**]. <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, pp. 19–22.

A general statement as to damage caused by fungi and their mode of growth and dissemination. Particular mention made of Windsor pear blight, thought to be caused by same fungus, as that causing apple scab, and for which ammoniacal copper carbonate is recommended; shot-hole fungus; bitter rot of apple, for which carbonate of copper and sulphide of potassium is recommended; strawberry leaf-blight, to be treated with Bordeaux mixture or 1 pound hyposulphite of soda in 10 gallons of water before disease appears; anthracnose of the vine, leaf spot, fire blight, peach rust, plum rust, and fig blight were incidentally mentioned. Peach rust sometimes goes by the name of yellows. (J. F. J.)

1107. COBB, N. A. **Plant diseases and how to prevent them.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Apr., 1892, pp. 276–303, pl. 4, figs. 26.

Treats of the diseases mentioned below, giving sketch of life history of the fungus and recommendations of preventives. (1) Of the apple: (*a*) Apple scab or "Tasmanian black spot," caused by *Fusicladium dendriticum*, for which is recommended ammoniacal carbonate of copper, modified eau céleste, or Bordeaux mixture; (*b*) powdery mildew, caused by *Podosphæra kunzei* Lév., for which ammoniacal carbonate of copper or modified eau céleste are recommended; (*c*) bitter or ripe rot, caused by *Glœosporium versi-color* B. & C., and treated with ammoniacal copper carbonate; (*d*) moldy core, treated by modified eau céleste or ammoniacal copper carbonate; (*e*) water core; (*f*) an obscure disease causing the fruit to become distorted and misshapen. (2) Diseases of pears: (*a*) Pear scab or Windsor pear-blight, caused by *Fusicladium pyrinum* and treated by same fungicides as apple scab; (*b*) leaf-blight (*Entomosporium maculatum*), which has not appeared in Australia (3) Shot-hole disease of apricot and other stone fruits, caused by *Phyllosticta circumscissa* and treated with Bordeaux mixture, ammoniacal copper carbonate, or eau céleste. (4) Diseases of the vine: (*a*) Anthracnose or "black spot," caused by *Glœosporium ampelinum* Sacc., and treated by cutting off and burning affected parts, using lime and sulphur and applying Bordeaux mixture or eau céleste; (*b*) tufted leaf-blight, caused by *Cercospora viticola*, for which Bordeaux mixture is recommended. (5) Strawberry leaf-blight, caused by *Sphærella fragariæ*, for which burning the diseased leaves and spraying with Bordeaux mixture or ammonia carbonate of copper is recommended. (6) Pumpkin-leaf Oidium, caused by *O. erysiphoides*, treated with flowers of sulphur or Bordeaux mixture. (7) Powdery mildew of rose, caused by *Sphærotheca pannosa* and treated with flowers of sulphur or Bordeaux mixture. The formula for carbonate of copper and descriptions of spraying apparatus are also given. (J. F. J.)

1108. COBB, N. A. **Plant diseases and how to prevent them.** <Agr. Gaz. N. S. Wales, vol. III, Sydney, June, 1892, pp. 436–439, figs. 3.

Describes, (1) "Pourridie or moldy root of the vine," caused by *Agaricus melleus;* recommends as a remedy thorough drainage. (2) Tufted leaf-blight of the bean, caused by a fungus which is not named; recommends rotation of crops and advises trial of Bordeaux mixture. (3) Apple canker, caused by some mechanical injury to the bark which is seized upon by some fungus and the healing thereby prevented. Pruning and the use of whitewash are recommended as remedies. (J. F. J.)

1109. CRAIG, JOHN. **A destructive disease affecting native plums.** <Ottawa Nat., vol. VI, Ottawa, Nov., 1892, pp. 109–112, fig. 1.

Refers to disease caused by *Cladosporium carpophilum* and quotes description given by Pammel, of Iowa. Describes the characters and notes the varieties affected. Recommends use of weak solution of copper sulphate, 1 ounce to 25 gallons of water. (J. F. J.)

1110. CRAIG, J. **Fusicladium on cherry.** <Ottawa Nat., vol. VI, Ottawa, Nov., 1892, p. 115.

Refers to the presence of *Fusicladium dendriticum* on the fruit and foliage of cherry causing great loss where occurring. (J. F. J.)

1111. DIVISION OF VEGETABLE PATHOLOGY. **Pear blossom-blight.** <Fla. Disp. Farm, and Fruit Grower, n. ser., vol. IV, Jacksonville, Apr. 21, 1892, p. 304, ½ col.

A letter written from the U. S. Department of Agriculture to L. B. Wombwell, State commissioner of agriculture, describing the method of spread of the disease by insects. Its spread through the orchard may possibly be prevented by spraying at the time of blooming. (J. F. J.)

1112. DOBSON, W. R. **Diseases of plants [peach rot].** <St. Louis Republic, St. Louis, May 15, 1892, ½ col.

Refers to the great destruction caused by rot (Monilia), and considers best remedy burning diseased peaches and branches. A dilute solution of copper and ammonium carbonate said to prevent the rot, but to injure the leaves (see also Colman's Rural World, vol. XL, May 26, 1892, p. 163, ⅜ col.). (J. F. J.)

1113. GARMAN, H. **Bordeaux mixture for apple pests.** <Ky. Agr. Exp. Sta. Bull. No. 44, Lexington, Jan., 1893, pp. 32, figs. 3.

Describes the appearance of apple rot caused by *Glœosporium versicolor*. Discusses the source of the rot and gives the microscopical characters of the fungus. This is followed by details of a number of experiments. The results of these show that Bordeaux mixture causes an increase in size of leaves, in numbers and size of fruits, prevention of scab and leaf spot, and a lessening of injury from rot. Apple scab can be treated with the same fungicide as rot. (J. F. J.)

1114. KELLERMAN, W. A. **Vegetable pathology, May.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, July, 1892, pp. 70–71.

Notes that peach curl has been abundant and describes its general characters. Refers also to black knot and bramble rust, advocating the destruction of weeds to prevent various species of fungi from infesting cultivated crops. (J. F. J.)

1115. [KIMBER, W.] **Visit to Angaston.** <Gard. and Field, vol. XVII, Adelaide, Feb. 17, 1892, p. 186, 1½ col.

Gives an account of apple orchard badly affected by *Fusicladium dendriticum*. (J. F. J.)

1116. MACOWAN, P. **Leaf-blight and powdery mildew in fruit trees.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, July 16, 1891, pp. 1–3, figs. 2.

Gives figures of amount of fruit sent out from California and refers to the work required to combat fungous pests in America. Quotes Circular No. 10 (treatment of nursery stock for leaf-blight and powdery mildew) of the Division of Vegetable Pathology. (J. F. J.)

1117. MCALPINE, D. **Report on peach and plum leaf-rust (Puccinia pruni).** <Dept. of Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 138–148.

Describes the disease and gives the life history of the fungus causing it. Notes the varieties of fruit affected the distribution of the disease, and suggests various remedies, among them the use of Bordeaux mixture and sulphate of iron dissolved in water at the rate of 1 pound to 8 gallons. (J. F. J.)

1118. [MEEHAN, THOS.] **Black knot in the plum.** <Meehan's Monthly, vol. II, Germantown, Pa., June, 1892, p. 93, ½ col.

Mentions various hosts of *Plowrightia morbosa*, and states that it is probably this same fungus which produces knots on the roots of young peach trees near the collar. (J. F. J.)

1119. MILLS, ——. **[Fire blight.]** <Dept. of Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes the occurrence of fire blight at Dundas and remarks upon its rapid spread. (J. F. J.)

1120. PULVER, ——. **[Peach rust.]** <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, p. 24.

Notes occurrence of disease at Wagga Wagga, where it is called "yellows." (J. F. J.)

1121. [ROBIN, A. B.] **Diseased cherry trees.** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, pp. 182–183, $1\frac{1}{10}$ col.

Records a disease of cherry trees in Nuriootpa [identified by N. A. Cobb as due to *Monilia fructigena*]. On p. 183 a solution of sulphate of iron is recommended by Cobb as a spray. (J. F. J.)

1122. SCOBIE, ——. **[Discussion of fruit-tree diseases.]** <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, pp. 23–24.

Mentions various diseases observed, such as apple scab, bitter rot, strawberry leaf-blight, disease of the vine, fire blight, and peach and plum rust. (J. F. J.)

1123. [VARIOUS.] **Pear blight.** <Ann. Rept. State Board Hort. of Cal. for 1891, Sacramento, 1892, pp. 414–415.

A discussion upon the subject, some considering the disease occurring on California trees to be true pear blight (*Bacillus amylovorus*) and others as something different. (J. F. J.)

(See also Nos. 1057, 1061, 1083, 1085, 1086, 1112, 1142, 1157, 1158, 1172, 1182, 1204, 1210, 1215.)

IV.—DISEASES OF FOREST AND SHADE TREES.

1124. [ANON.] **[Forest tree fungi.]** <Gard. and Forest, vol. III, New York, July 16, 1890, p. 352, 8 lines.

Notes *Glœosporium aridum* on ash and *Microstoma juglandis* on leaves of hickory as being abundant. (J. F. J.)

1125. [ANON.] **Pine blister.** <Gard. Chron., 3d ser., vol. IX, London, May 9, 1891, pp. 598, 599, fig. 1.

States that the disease is caused by *Peridermium pini*, and believes some connection exists between it and *Coleosporium senecionis*. Recommends removal of Groundsel (*Senecio jacobœa*) from vicinity of trees. (J. F. J.)

1126. BRUNCHORST, I. **Nogle sygdomme i de vestlandske træplantninger.** <Naturen, vol. XV, Bergen, Sept., 1891, pp. 257-269, pl. 1.

Pinus sylvestris and *Larix europœa* are often injured in Norway by fungi. The author gives a popular account of some of these diseases, accompanied by some figures giving the Norwegian names for the diseases, but omitting the scientific names of the fungi. (T. H.)

1127. [EDITORIAL.] **[Sycamore blight.]** <Gard. and Forest, vol. III, New York, June 18, 1890, p. 304, $\frac{1}{6}$ col.

Notes the occurrence of *Glœosporium nervisequum* on Sycamore trees in Central Park, N. Y. Asks for reports of occurrence in other places. (J. F. J.)

1128. J. ——. **Fungoid growth on trees.** <The Garden, vol. XXXIX, London, Jan. 24, 1891, p. 88, $\frac{1}{2}$ col.

Notes the occurrence of decay in trees and ascribes a particular case to the growth of fungous mycelium in a post near by. This fungus eventually attacked the roots of the tree. Another tree was found to have been infected by mycelia from a plank lying in contact with the roots. (J. F. J.)

1129. M. ——. **Destruction of tree roots by fungi.** <Agr. Jour. Cape Colony, vol. III, Cape Town, Mar. 19, Apr. 9, 1891, pp. 169-170, 182-183.

Notes that the common root destroyers of South Africa are *Agaricus melleus* and *Polyporus sulphureus*. Gives a sketch of the life history of each. For the first he recommends the removal of the earth about the collar of the tree and then the application of sulphate of iron or sulphate of copper, filling in again with fresh loam. For Polyporus there is no cure. The latter gains an entrance into the tree trunk through wounds in the bark (see Gard. Chron., 3d ser., vol. IX, June 13, 1891, p. 734, 2 col.) (J. F. J.)

1130. [MEEHAN, THOS.] **Diseases in Rhododendrons.** <Meehan's Monthy, vol. II, Germantown, Pa., June, 1892, p. 89, 1 col.

Describes the work of a fungus similar to that attacking pear trees. Also notes work of mycelium of a species of *Agaricus* attacking the roots. Flowers of sulphur destroyed the Agaric and the leaves recovered their normal green color. Suggests that copper solution might destroy the fungus working on the branches. (J. F. J.)

1131. OLLIFF, A. SYDNEY. **Diseased pepper tree.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Nov., 1891, p. 670.

States that the disease is due to a fungus arising from the presence of honeydew caused by a species of scale insect. Recommends kerosene emulsion as a remedy for the scale and thus a preventive of the fungous growth. (J. F. J.)

(See also Nos. 1046, 1062, 1082.)

V.—DISEASES OF ORNAMENTAL PLANTS

1132. [ANON.] **[New primula disease.]** <Am. Florist, vol. VII, Chicago and New York, Dec. 31, 1891, p. 454, $\frac{1}{16}$ col.

Notes a mildew of primula new to Great Britain, due to *Ramularia primulæ* Thüm. (J. F. J.)

1133. [ANON.] **Pancratiums diseased.** <Gard. Chron., 3d ser., vol. IX, London, Feb. 7, 1891, p. 182, $\frac{1}{3}$ col.

The disease is caused by *Saccharomyces glutinis*. Recommends removal and burning of soil where bulbs are growing, and destruction of all diseased portions of plants. Soak bulbs in solution of potassium sulphide and use every means to have healthy plants. (J. F. J.)

1134. [ANON.] **The carnation rust.** <Gard. and Forest, vol. V, New York, Jan. 13, 1892, pp. 18, 19, figs. 2, $1\frac{1}{2}$ col.

Notes the extent of the disease in this country caused by *Uromyces caryophyllinus*. Thinks cuttings dipped in Bordeaux mixture will be free from disease. (J. F. J.)

1135. ARTHUR, J. C. **Fungus on carnations.** <Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 462, $\frac{1}{3}$ col.

States disease to be a rust known long ago in Europe and only recently brought to this country. The fungus may be recognized by brown spots on the leaves and stems $\frac{1}{16}$ to $\frac{1}{4}$ of an inch long, filled with a dark, loose powder, which readily comes off on the fingers. Suggests use of only healthy cuttings, clean cultivation, and fumigation of greenhouse with sulphur before planting in benches. (J. F. J.)

1136. HALSTED, B. D. **A chrysanthemum blight.** <Gard. and Forest, vol. IV, New York, Nov. 25, 1891, p. 560, $\frac{1}{4}$ col.

Notes peculiar blotching of leaves due to species of *Septoria*. Gives brief sketch of growth. Spraying with copper compounds recommended. (J. F. J.)

1137. HALSTED, B. D. **Alternanthera leaf-blight.** <Gard. and Forest, vol. V, New York, Feb. 3, 1892, pp. 56–57, $\frac{1}{2}$ col.

Describes appearance of plants affected by a fungus closely related to *Phyllosticta amaranthi*. Thinks either Bordeaux mixture or ammoniacal copper carbonate solution would be an effectual preventive. (J. F. J.)

1138. HALSTED, B. D. **Petunia blight.** <Gard. and Forest, vol. V, New York, Mar. 23, 1892, p. 141, $\frac{1}{4}$ col.

Disease due to *Ascochyta petuniæ*. Describes appearance. *Septoria*, perhaps new, and for which *S. petuniæ* is provisionally proposed, was also found on leaves. Diseases can be held in check by use of fungicides. (J. F. J.)

1139. KELLERMAN, W. A. **Some fungous pests of greenhouse plants.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 20–23.

Gives descriptions of rust of carnations, caused by *Uromyces caryophyllinus*, and damping off, caused by species of *Pythium*. The best preventives seem to be good ventilation, not too high temperature, and good cultivation. In the discussion Mr. Warner stated that sulphur could be used to advantage in arresting the damping-off fungus. (J. F. J.)

1140. THAXTER, R. **Fungus in violet roots.** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 166–167.

Notes the diseased condition of violets, which may or may not be connected with *Phyllosticta violæ* attacking the leaves. Finds a fungus on the roots identified as *Thielavia basicola*, which is the same as *Helminthosporium fragile* and *Torula basicola*. Considers it doubtful if the fungus is wholly responsible for the diseased condition of the violet roots (see Exp. Sta. Rec., vol. III, June, 1892, p. 773). (J. F. J.)

(See also Nos. 1039, 1044, 1063, 1107, 1175, 1220, 1222.)

D.—REMEDIES, PREVENTIVES, APPLIANCES, ETC.

1141. ALWOOD, W. B. **Treatment of diseases of the grape.** <Va. Agr. Exp. Sta. Bull. No. 15, Blacksburg, Apr., 1892, pp. 31–43.

Notes the amount of damage caused by fungi on grapes, and treats the following topics: Preparations used as fungicides, formulæ for fungicides, methods of preparation, cost, manner of treatment of vineyards, results of tests made with fungicides, and "Is sprayed fruit unwholesome?" Recommends use of fungicides, especially weak Bordeaux mixture, and concludes that there is no danger from the use of sprayed grapes. (J. F. J.)

1142. ANDERSON [H. C. L.] **[Fruit-tree diseases.]** <Dept. Agr. N. S. Wales, Bull. No. 4, Sydney, Feb., 1891, pp. 25–26.

Refers to peach rust and success in treating trees with sulphate of iron. Wood ashes used as fertilizer. Large doses of kainit enabled the trees to throw off the disease better than those dressed with wood ashes or lime. Recommends spraying trees in winter with 1 pound of sulphate of iron in 8 gallons of water and applying potash in addition. (J. F. J.)

1143. [ANON.] **A new fungicide.** <Am. Florist, vol. VII, Chicago and New York, Mar. 3, 1892, p. 640, $\frac{1}{10}$ col.

Mentions a dry powder made by C. H. Joosten, New York, that when applied is like a cloud of smoke and so reaches every part of the plant. (J. F. J.)

1144. [ANON.] **Copper salts for the prevention and palliation of the potato disease.** <Gard. Chron., 3d ser., vol. XI, London, Mar. 26, 1892, p. 403, $\frac{1}{3}$ col.

Notices the work of Messrs. Robt. Veitch & Son for the prevention of the disease, giving negative results with the copper, but successful results in earthing up. Notes also that a consular report records the successful use of copper sulphate and lime for potato disease in France. (J. F. J.)

1145. [ANON.] **Copper solution [for tomatoes].** <Gard. Chron., 3d ser., vol. XI, London, Apr. 16, 1892, pp. 505–506, $\frac{1}{6}$ col.

Gives directions for making spraying solution with $4\frac{1}{2}$ pounds of sulphate of copper dissolved in $3\frac{1}{2}$ gallons of water and $3\frac{1}{2}$ pounds of carbonate of soda and $\frac{1}{4}$ pound of molasses; stir, allow to stand twelve hours, and then dilute with 22 gallons of water. Spray two or three times during season, stopping when fruit begins to color. This is the remedy for mildew. (J. F. J.)

1146. [ANON.] **History of the Bordeaux mixture.** <Rural New Yorker, vol. L, New York, Oct. 17, 1891, p. 741, 1 col.

Gives an account of the first use of Bordeaux mixture as a fungicide, and mentions many experiments since made with it. Notes that it is often improperly applied, and that it should not be used as a spray after the grapes begin to color. (J. F. J.)

1147. [ANON.] **Mildew on strawberries.** <Gard. Chron., 3d ser., vol. XI, London, Jan., 1892, p. 58, $\frac{1}{4}$ col.

Considers mildew due to method of cultivation. Recommends having beds slope toward south and plenty of air circulating. In house culture keep air stirring and strew sulphur about. Out of doors dressings of Bordeaux mixture would be beneficial. (J. F. J.)

1148. [ANON.] **[Plum rot.]** <Am. Agr., vol. L, New York, Feb., 1891, p. 96, $\frac{1}{8}$ col.

Recommends ammoniacal copper carbonate solution as a remedy, spraying first when plums are size of peas, and thereafter every six or seven days until the fruit is two-thirds grown. (J. F. J.)

1149. [ANON.] **Potato culture.** <Ann. Rept. Sec. for Agr., Nova Scotia, for 1890, Halifax, 1891, pp. 60–65.

On p. 62 notes that nitrogenous fertilizers increase percentage of diseased tubers; with mineral fertilizers the percentage was much less. (J. F. J.)

1150. [ANON.] **Potato disease.** <Nat. Provisioner, vol. IV, New York, Mar. 19, 1892.

Mentions experiments made in France to prevent potato disease with sulphate of copper, lime, and water called "bouillie Bordelaise." States that the addition of molasses enables the mixture to stick to the leaves and is not washed off by rain. (J. F. J.)

1151. [ANON.] **Potato disease and the copper treatment.** <Gard. Chron., 3d ser., vol. XI, Feb. 6, 1892, London, p. 178, $\frac{1}{2}$ col.

From the *Morning Post* it is learned that the Highland and Agricultural Society has been conducting experiments on potatoes. The spray of Bordeaux mixture has entirely failed to restrain the fungus of the potato blight. (M. B. W.)

1152. [ANON.] **Renseignements sur la maladie des pommes de terre et sur les traitements effectués en 1891.** <Chron. Agr. du Canton de Vaud, vol. V, Lausanne, Mar. 10, 1892, pp. 94–99.

A notice of the results of experiments made by various persons at different places to prevent potato rot. The principal substance used was Bordeaux mixture and the treatment was generally successful. (J. F. J.)

1153. [ANON.] **Revue Horticole.** <Nouv. Ann. Soc. d'Hort. Gironde, June, 1891, Bordeaux, pp. 108–109.

A note on the successful treatment of chlorosis with sulphate of iron. States that chlorosis had been thought to be due to lack of light, improper nutrition, etc., but the chlorosis spoken of was due to lack of iron. The remedy consisted in scattering around each diseased tree in February 250 grams of dry sulphate of iron. (M. B. W.)

1154. [ANON.] **Rust in wheat.** <Gard. Chron., 3d ser., vol. X, London, Oct. 31, 1891, p. 521, $\frac{1}{8}$ col.

Quotes from Mark Lane Express in relation to prize of £10,000 offered in Australia for successful preventive of wheat rust. A solution of copper sulphate (1 part to 400 of water) destroys the vitality of the spores, and spraying with 1 ounce of sulphate of iron in a gallon of water retarded appearance of rust, destroyed the rust when it appeared, and prevented its appearance for fourteen days afterward. (J. F. J.)

1155. [ANON.] **Rust in wheat.** <Agr. Gaz. N. S. Wales, vol. III, Sidney, March, 1892, pp. 221–226.

Gives the substance of the recommendations of the wheat conference in relation to treatment for rust. (J. F. J.)

1156. [ANON.] **Spraying to prevent damage by frost.** <Am. Gard., vol. XIII, New York, Apr., 1892, p. 226, $\frac{1}{8}$ col.

States that when there is danger of a frost, if the plants be sprayed in the early morning with clear, cold water serious damage will be prevented. (J. F. J.)

1157. [ANON.] **The black knot of the plum and cherry.** <Am. Gard., vol. XIII, New York, Aug., 1892, pp. 478–480, pl. 2.

Mention of the usual methods of eradicating black knot, that is, cutting out and burning, and an outline of the New York State law passed against allowing the disease to remain in orchards. (J. F. J.)

1158. [ANON.] **The strawberry leaf disease.** <Gard. Chron., 3d. ser., vol. X, London, July 11, 1891, p. 53, fig. 1, ½ col.

Refers to disease caused by *Sphærella fragariæ* and gives as a remedy carbonate of copper 3 ounces, dissolved in 1 quart of water, diluted with 20 gallons of water; diseased leaves should also be burned. (J. F. J.)

1159. [ANON.] **The treatment of disease in plants by means of copper compound.** <Gard. Chron., 3d ser., vol. X, London, Aug. 15, 1891, p. 196, ⅛ col.

Refers to successful treatment of potato diseases by lime and copper sulphate; the same also used for disease of sugar beets caused by *Peronospora schachtii*. (J. F. J.)

1160. [ANON.] **Vermorel's appliances for the treatment of scale on orange trees, the pear-leaf slug, and other pests.** <Agr. Jour. Cape Colony, vol IV, Cape Town, Oct. 8, 1891, pp. 80–82.

Describes the various appliances used for both insecticides and fungicides. (J. F. J.)

1161. [ANON.] **Visit to Angaston district.** <Gard. and Field, vol. XVII, Adelaide, Feb., 1892, pp. 184–186.

Notes successful use of eau céleste in combating the shot-hole fungus of apricot trees. Pear and apple scab also treated successfully. Gives a statement of discussion on use of fungicides to prevent fungous diseases, such as scab, curl-leaf, beet disease, etc. (J. F. J.)

1162. ARMSTRONG, L. **Carnation disease.** <Am. Gard., vol. XIII, New York, Dec., 1892, p. 762, ⅕ col.

Notes that the disease can be checked by using sulphur compound, made by subjecting sulphur and quicklime to intense heat; use 1 gill of this to 2 gallons of water, and syringe the plants twice a day. Compound seems to act by promoting healthy root action. (J. F. J.)

1163. ARTHUR, J. C. **Report of the botanical department [of the Indiana Agricultural Experiment Station].** <Fourth Ann. Rept. Ind. Agr. Exp. Sta. for 1891, Feb., 1892, pp. 23–28.

Gives a brief notice of the work of the station to prevent diseases of corn, oats, wheat, potatoes, beets, and carnations. (J. F. J.)

1164. BABO, C. VON. **Sulphuring vines for Oidium.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 100, ⅓ col.

Gives directions for use of sulphur for Oidium, and states that rain causes it to lose its effectiveness. (J. F. J.)

1165. BARMY, DR. **Préservation contre les gelées de printemps.** <Prog. Agr. et Vit., 9th year, No. 27, Montpellier, July 3, 1892, pp. 5–6.

It has been long known that the production of artificial clouds by burning tar may prevent the killing of buds by frost in the spring. The author recommends using this treatment not only in spring, but during all the winter, when frost is expected to occur, so as to preserve the entire growth of the vineyard. (T. H.)

1166. BEDFORD, S. A. **Smut.** <Exp. Farms Rept. for 1891, Ottawa, 1892, p. 252.

Notes occurrence of smut on wheat in Province of Manitoba, and gives details of experiments made in 1889 for prevention. Bluestone gave better results than salt or scalding. (J. F. J.)

1167. BLERSCH, F. **Bluestone for steeping grain.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Sept. 10, 1891, pp. 61, 62, 1 col.

Gives formula for steeping wheat, and states that a ½ per cent solution of vitriol is strong enough to destroy smut. Does not recommend the Jensen hot-water treatment, because of the difficulty of maintaining the water at the specified temperature of 132° to 135° F. (J. F. J.)

1168. BLERSCH, F. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Aug. 27, 1891, p. 46, ½ col.

Refers to experience of Gilfillan (see No. 1187), and states his belief that the bad results from the use of vitriol were due to other circumstances, such as seed wheat passing through a threshing machine, soaking wheat too long and then sowing in dry weather, or lack of lime in the soil. (J. F. J.)

1169. "BOSTON SUBURB." **Sand and damping off.** <Am. Gard., vol. XIII, New York, Apr., 1892, p. 226, ¼ col.

Says the use of a layer of sand might prevent damping off of cuttings. (J. F. J.)

1170. BRUNK, T. L. **[Spraying experiments and apparatus.]** <Fourth Ann. Rept. Md. Agr. Exp. Sta. for 1891 [College Park], 1892, pp. 381–399, figs. 7.

Describes experiments with apples to prevent depredations by insects and fungi. Gives account of various fungicides, such as ammoniacal copper carbonate solution, carbonate of copper and carbonate of ammonia, kerosene emulsion and copper carbonate (each used in combination with Paris green), and improved ammoniacal copper carbonate. Believes kerosene emulsion, copper carbonate, and Paris green mixture to be effective in combating both insects and fungi attacking apple and pear. Gives successful results of spraying watermelon, cucumber, muskmelon, pumpkin, and squash vines with Bordeaux mixture to control *Glœosporium lindemuthianum*. Tomatoes attacked by *Cladosporium fulvum* were sprayed with Bordeaux mixture and carbonate of copper mixture, but with little success. Strawberry leaf-blight was successfully treated with ammoniacal copper carbonate solution and Bordeaux mixture. Blackberry rust also treated, but without apparent success. The use of fungicides combined with grubbing out infected plants will eradicate this disease in time. Quince leaf-blight was treated successfully with Bordeaux mixture two times in early spring, and copper carbonate and carbonate of ammonia mixture two or three times in the latter part of the season. Descriptions, with illustrations, are given of various forms of spraying apparatus. (J. F. J.)

1171. BUTZ, GEO. C. **Information on spraying fruits.** <Pa. State College Agr. Exp. Sta. Bull. No. 19, State College, Apr, 1892, pp. 13, figs. 6.

Describes results of spraying to destroy both insect and fungous pests, giving formulæ for Bordeaux mixture and ammoniacal carbonate of copper, together with description and figures of various forms of pumps. (J. F. J.)

1172. CHESTER, F. D. **A few common diseases of crops and their treatment.** <Del. Agr. Exp. Sta. Bull. No. 15, Newark, Jan., 1892, pp. 16.

Discusses the present status of treatment of vine diseases by means of Bordeaux mixture, copper carbonate in suspension, copper soda hyposulphite, Johnson's mixture (copper sulphate and ammonium carbonate), and copper and ammonium carbonate mixture. Both copper soda hyposulphite and Johnson's mixture injured the foliage, while the copper and ammonium carbonate mixture it is believed promises good results. In discussion of pear leaf-blight considers that Bordeaux mixture and Paris green will give good results. In treatment of peach rot records good results from use of copper and ammonium carbonate mixture. Several diseases of potato are discussed, viz, that caused by *Phytophthora infestans* (which can be controlled by Bordeaux mixture), a bacterial disease, and one caused by *Macrosporium solani*. This last is also kept in check by Bordeaux mixture. Directions are given for the preparation of the various fungicides mentioned in the bulletin. (J. F. J.)

1173. CHESTER, F. D. **Spraying with sulphide of potassium for the scab of the pear.** <Del. Agr. Exp. Sta. Bull. No. 7, Newark, Mar., 1890, pp. 11–14.

Gives details of experiments for treatment of *Fusicladium pyrinum*. The solution of potassium sulphide had a strength of ½ ounce to a gallon of water, and the sprayed trees produced about 25 per cent more marketable fruit than the unsprayed. (J. F. J.)

1174. CHUARD, E. **Adhérence aux feuilles des plantes de composés cuivriques destinés combattre leurs maladies.** <Chron. Agr. du Canton de Vaud, vol. V, Lausanne, Mar. 10, 1892, pp. 99–101.

Refers to results obtained by Girard and notes difference in those from his own experiments. In order of adhesiveness Girard found Perret mixture to stand first, Masson mixture second, and ordinary Bordeaux mixture last. Chuard found eau céleste to be first, Masson mixture second, and Bordeaux mixture third. Believes different results arise from different formulæ used in the two cases. Experiments were made with plants attacked by *Peronospora*. (J. F. J.)

1175. COBB, N. A. **Dialogue concerning the manner in which a poisonous spray does its work in preventing or checking blight.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Dec., 1891, pp. 779–786, figs. 6.

Describes, in the form of a dialogue, blight of the rose, with its mode of growth, and method of treating it by spraying with fungicides. Deals especially with the latter subject, stating that three sprayings of three seconds each, with intervals between long enough to become dry, were more effectual in spreading the fungicide than one spraying of nine consecutive seconds. (J. F. J.)

1176. C[OOKE], J. H. **The Malta potato disease.** <Medit. Nat., vol. II, Malta, June, 1892, pp. 194–195.

Notes the destruction of potatoes caused by *Phytophthora infestans*, and states that sulphate of iron, 1 ounce to 4 gallons of water, proved an effective remedy. (J. F. J.)

1177. CRAIG, JOHN. **Annual report of the horticulturist.—Fungicides.** <Exp. Farms Ann. Rept. for 1891, Ottawa, 1892, pp. 144–148.

Gives results of experiments with fungicides for the prevention of apple scab, a modified eau-céleste solution giving the best results; for grape mildew and gooseberry mildew, potassium sulphide, 1 ounce in 3 gallons of water, gave the best results. Directions for making copper carbonate solutions are given. (J. F. J.)

1178. CRAIG, JOHN. **Apple-scab remedy.** <Orange Judd Farmer, vol. XI, Chicago, Mar. 19, 1892, p. 180, ⅔ col.

Gives directions for making carbonate of copper at home. (J. F. J.)

1179. DAVIS, G. C. **Benefits of lime with the arsenites.** <Farm, Field, and Stockman, vol. XV, Chicago, Feb. 27, 1892, p. 200, 1 col.

States that Bordeaux mixture in connection with arsenites is useful both as an insecticide and a fungicide. Recommends 4 pounds of lime and 2 pounds of copper sulphate to a barrel of water, adding ¼ to ⅓ of a pound of some arsenite to the barrel. London purple or Paris green may be used. (J. F. J.)

1180. DESPEISSIS, J. A. **Mechanical application of insecticides.** <Agr. Gaz. N. S. Wales, vol. II, Sydney, Oct., 1891, pp. 600–608, pl. 2, figs. 15.

Describes various forms of apparatus for the distribution of fungicides and insecticides. Chief among them is the "Strawsonizer" and the Vermorel spraying pump and nozzle. (J. F. J.)

1181. E.——, C. **Steeping grain in sulphur and lime.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 8, 1891, p. 84, ⅛ col.

States that seed soaked in a mixture of sulphur and lime, 20 pounds of each in 100 gallons of water, produced a crop entirely free from smut. This was especially so with oats. (J. F. J.)

1182. FALCONER, [WM.]. **Gooseberry mildew.** <Meehan's Monthly, vol. II, Germantown, Pa., 1892, p. 61, ⅛ col.

Mulching ground may act as a partial preventive. Budding with Missouri currant increases the disease. Locality and cultivation have much to do with its presence or absence. (J. F. J.)

1183. FISCHER, A. **Remedy for the potato disease.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 99, ⅕ col.

Notes good results obtained by Aimé Girard in use of Bordeaux mixture (100 parts of water, 2 parts bluestone, and 2 parts of lime). (J. F. J.)

1184. G.———, **Fungus on carnations.** <Am. Florist, vol. VII, Chicago and New York, Jan. 7, 1892, p. 462, $\frac{1}{10}$ col.

Advises coating pipes [in greenhouses] with sulphur for prevention of disease. (J. F. J.)

1185. G.——, W. W. **The potato disease question.** <Gard. Chron., 3d ser., vol. X, London, Dec. 5, 1891, pp. 671, 672, 2 cols.

Thinks it fairly established that the Bordeaux mixture is a remedy for Phytophthora. Advises the selection of seed which will produce good crops, yet with tops suitable for treatment. (M. B. W.)

1186. GARDNER, EDW. **Steeping grain in sulphur and lime.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Oct. 22, 1891, p. 95, ⅙ col.

Recommends for smut, soaking in solution of 1½ pounds of sulphur, 3 pounds lime, and 4 gallons of water, letting it stand for eighteen hours, stirring it thoroughly after the first eight hours. (J. F. J.)

1187. GILFILLAN, E. T. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, July 30, 1891, p. 18, ¼ col.

States that steeping grain in vitriol for smut prevents germination, while the use of lime was very satisfactory. (J. F. J.)

1188. GILLETTE, C. P. **Experiments with arsenites. (Combining arsenites with fungicides.)** <Iowa Agr. Exp. Sta. Bull. No. 10 [Ames], Aug., 1890, pp. 416–418.

Gives details of effects of combination of arsenites and fungicides on foliage. States that London purple in combination with Bordeaux mixture did not in the least injure peach or plum foliage in proportion of 1 pound to 50 gallons of Bordeaux mixture. One pound to 10 gallons injured plum to an extent of 10 per cent, but apple not at all. London purple when combined with simple sulphate of copper solution was very injurious, even when used at the rate of 1 pound to 200 gallons of solution. Applied with water in this proportion, no injury would result. The arsenites when combined with ammoniacal copper carbonate are generally less injurious than when used with water alone. (J. F. J.)

1189. GOFF, E. S. **Experiment in the treatment of apple scab.** <Eighth Ann. Rept. Wis. Agr. Exp. Sta., Madison, 1892, pp. 160–161.

Brief statement of results. Fungicides used were copper carbonate dissolved in ammonia and suspended in water, sulphur powder, and mixture No. 5. The last was most efficacious, but it injured the foliage. The results show that spraying before the flowers open is very important. (J. F. J.)

1190. Goff, E. S. **Treatment of the potato blight.** <Eighth Ann. Rept. Wis. Agr. Exp. Sta., Madison, 1892, pp. 138–141, figs. 2.

Gives results of a series of experiments with Bordeaux mixture of varying strengths. The treatment was successful, as shown by an increased yield and freedom from blight. (J. F. J.)

1191. [Goodell, H. H.] **Fourth Annual Report of the Hatch Agricultural Experiment Station of the Massachusetts Agricultural College**, Amherst, Jan., 1892, pp. 14, pl. 1.

On pp. 11 and 12, under head of "horticultural division," mentions favorable results of experiments with fungicides to prevent apple scab, peach and plum rot, pear and plum leaf-blight, and potato blight and rot. No details are given. (J. F. J.)

1192. Halsted, B. D. **Field experiments with soil and black rots of sweet potatoes.** <N. J. Agr. Exp. Sta. Special Bull. M, New Brunswick, Nov. 23, 1891, pp. 1–17, pl. 1.

Gives details of experiments, with list of manures used (see Exp. Sta. Rec., vol. III, May, 1892, p. 703). (J. F. J.)

1193. H[alsted], B. D. **Spraying against pear blight.** <Gard. and Forest, vol. III, New York, Oct. 15, 1890, p. 505, ¼ col.

Notes the value of spraying for prevention of leaf-blight, and the saving of a considerable amount of money on the crop. (J. F. J.)

1194. Hammond, ——. **Spraying fruit.** <Farm, Field, and Stockman, vol. XV, Chicago, Feb. 6, 1892, p. 127, ⅜ col.

States that spraying apple trees (Wythe variety) with London purple, followed by a fungicide, caused, after a second double spraying, the leaves to fall from many trees. Ben Davis apple was not injured by a similar treatment. Vines sprayed with various solutions of sulphate of copper and sulphate of iron varied in their loss of fruit by black rot from 10 to 80 per cent. The best remedy was considered to be 2 pounds of sulphate of copper, 2½ pounds of carbonate of soda, and 1½ pints of ammonia to 40 gallons of water. Believes the latter might be increased 50 per cent. (J. F. J.)

1195. Hine, J. S. **Practical spraying at Ohio Experiment Station in 1891.** <Jour. Columbus Hort. Soc., vol. VI, Columbus, Sept., 1891, pp. 93–96.

Gives a statement of the work of the station to prevent fungous diseases and destroy insect pests. Notes that a dilute Bordeaux mixture (4 pounds of lime and 4 pounds of copper sulphate to 50 gallons of water) was as effective in preventing apple scab, leaf-spot, etc., as the old formula of 6 pounds of copper sulphate and 4 pounds of lime to 22 gallons of water. Claims the former is better for several reasons. Considers Bordeaux mixture gave the best results of any fungicide used, the dilute form giving as good effects as the other for many diseases. (J. F. J.)

1196. Humphrey, J. E. **Preventive treatment [of fungous diseases of plants].** <Ninth Ann. Rept. Mass. Agr. Exp. Sta. for 1891, Amherst, 1892, pp. 235–248, pl. 1.

Discusses the subject from the points of hygienic treatment and the use of fungicides, laying special stress upon good and clean cultivation. Describes the method of preparation of various fungicides, giving addresses of firms supplying chemicals, with prices. Mentions also methods of application of fungicides, and gives addresses of manufacturers of spraying pumps. Cautions the farmer against an unwise use of the fungicides, and details some experiences of those who have used the remedies recommended. In the concluding pages discusses various sorts of smut, those affecting oats, barley, wheat, corn, rye, and onions, giving directions for using the hot-water treatment [of Jensen]. The plate illustrates the forms of smut affecting various grains (J. F. J.)

1197. James, Joseph F. **Spraying for the prevention of plant diseases.** <Sci. Am. Sup. vol. XXXIII, New York, May 2, 1892, pp. 13635–13636.

Reviews in detail the advances made in this country and elsewhere during the past twenty years in the treatment of plant diseases and the prevention of insect injuries. Considerable space is devoted to a discussion of spraying from a hygienic standpoint. (B. T. G.)

1198. James, Joseph F. **Wheat rust and smut.** <Science, vol. XX, New York, Aug. 12, 1892, pp. 93–94, ⅓ col.

Calls attention to error made in Bulletin No. 83 of the experiment station of Michigan, where treatment for wheat smut is recommended for wheat rust (see also Cult. and Count. Gent., vol. LXII, Aug. 11, 1892, p. 596). (J. F. J.)

1199. Jensen, J. L. **Hot-water treatment for fungous [sic] diseases of cereals.** <Am. Agr., vol. LI, New York, July, 1892, pp. 410–411, 1 col.

Refers to idea that this treatment will prevent rust, but does not believe it will be at all efficacious. States that difference in climate causes a difference in length of time the seed should be treated for smut, being longer in warm than in cold climates. Believes sprinkling grain before immersing in hot water preferable to soaking. In his "improved method" the basket with the hot grain is placed for two minutes in a closed box. It is then spread on the floor and stirred for some minutes with a rake. Believes it would be best not to sow grain until four days after treating. (J. F. J.)

1200. KING, WM. R. **Gum in lemons.** <Fla. Disp. Farm and Fruit Grower, n. sér., vol. IV, Jacksonville, Aug. 18, 1892, p. 645, ½ col.

Gives directions for treatment of disease, scraping off gum, cutting away diseased bark, and washing with McMaster and Miller's insecticide, also spraying with same solution. The sores were painted with shellac varnish and the trees fertilized with 10 pounds of sulphate of potash each. (J. F. J.)

1201. KINNEY, L. F. **Fungicides and insecticides.** <R. I. Agr. Exp. Sta. Bull. No. 15, Kingston, Apr., 1892, pp. 11–25, figs. 6.

Gives the formula for Bordeaux mixture and ammoniacal copper carbonate solution; also the prices for copper compounds. Describes apparatus for spraying, the knapsack sprayer, and "Perfection" outfit. Discusses the use of fungicides in treating black rot of grapes, mainly by quoting from U. S. Department of Agriculture Reports, giving time of treatment and cost. For apple scab quotes from Ohio Agr. Exp. Sta. Bull. No. 9, vol. IV, n. ser., recommending dilute Bordeaux mixture (4 pounds of sulphate of copper and 4 pounds of lime in 50 gallons of water). Paris green may be used with the Bordeaux mixture as an insecticide. (J. F. J.)

1202. LODEMAN, E. G. **Combinations of fungicides and insecticides, and some new fungicides.** <Cornell Univ. Agr. Exp. Sta. Bull. No. 35, Ithaca, N. Y., Dec., 1891, pp. 315–338.

Gives details of experiments with carbonate of copper, sulphate of copper, hydrate of copper, borate of copper, and chloride of copper, all used in combination with arsenites. The results of the experiments are briefly as follows: The effect of ammoniacal carbonate of copper as a fungicide is not lessened when Paris green or London purple is added, and gave better results with 1½ ounces in 1 pint of ammonia than double the quantity in 22 gallons of water; but the combinations have a caustic effect on the foliage of most plants. Sulphate of copper with Paris green and London purple formed an unsatisfactory combination; hydrate of copper alone is not as effective as when applied with Bordeaux mixture, although it did little injury to the foliage; borate of copper has little fungicidal action and in combination with arsenites is caustic; chloride of copper gave better results than the Bordeaux mixture, but it must be weak (1½ ounces in 22 gallons of water injured the foliage of apple and peach trees). Mention is made of experiments in other places. In a note (p. 338) the formulæ for Bordeaux mixture and ammoniacal carbonate of copper are given. The only successful combination yet found is with Bordeaux mixture and the arsenites. With ammoniacal carbonate and the arsenites the foliage is usually seriously injured (see also Exp. Sta. Rec., vol. III, Washington, Mar., 1892, pp. 524–526). (J. F. J.)

1203. MARLATT, F. A. **A good spraying outfit for the general fruit-grower.** <Agr. Sup. Kansas Weekly Capital, Topeka, Mar. 3, 1892.

Mentions various spraying machines in use, and gives a list of articles, with prices, necessary for the work. Gives also addresses of firms manufacturing pumps. (J. F. J.)

1204. MAYNARD, S. T. **Experiments with fungicides and insecticides.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 1–32, pl. 11.

A report of work done at the station, at Northboro, and by various individuals under the direction of the horticulturist. The four fungicides used were Bordeaux mixture, ammoniacal carbonate of copper, sulphate of copper, and sulphate of iron. Short descriptions are given of the following diseases: Apple scab, pear leaf-blight, plum leaf-blight or shot-hole fungus, brown fruit rot, powdery mildew and black rot of the grape, potato rot, and black wart of plum and cherry. Experiments were made to prevent all of these, with generally good results. Paris green was used in combination with the Bordeaux mixture. The reports of the volunteer observers vary, but they note generally favorable results. Dr. Jabez Fisher describes a syringe for spraying, called by him the "Hydrospray." He also records good results in combating tomato rot by the use of 1 pound of copper sulphate in 1,000 gallons of water. The foliage was not injured and the spread of the fungus was checked. At Northboro, peach, plum, pear, and apple trees, grapevines, and black raspberries were treated. Bordeaux mixture injured the peach foliage, but ammoniacal solution checked the rot. Anthracnose of raspberries was successfully treated with Bordeaux mixture and copper sulphate, and potatoes were treated with Bordeaux mixture and Paris green with good results. It was also found that black knot of the plum could be destroyed by painting with "kerosene paste," made by mixing ordinary kerosene with French yellow or any other dry pigment. Crude petroleum would do equally well if thick enough not to spread over the limb (see Exp. Sta. Rec., vol. III, July, 1892, pp. 864–866). (J. F. J.)

1205. [MAYNARD, S. T.] **Outline of plans for using fungicides and insecticides for 1892.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 41–43.

Gives various treatments for apple, pear, plum, peach, grape, raspberry, blackberry, strawberry, and potato based on the previous year's experiments. (J. F. J.)

1206. [MAYNARD, S. T.] **Spraying apparatus.** <Mass. Hatch Agr. Exp. Sta. Bull. No. 17, Amherst, Apr., 1892, pp. 44–47, figs. 4.

Describes briefly horse apparatus, knapsack sprayers, and nozzles. Gives also statement of prices of chemicals. (J. F. J.)

1207. PAMMEL, L. H. **Experiments with fungicides.** <Iowa Agr. Exp. Sta. [Ames] Bull. No. 16, Des Moines, Feb., 1892, pp. 315–329, figs. 3.

Gives details of experiments to prevent corn smut, and records negative results when seed was treated by hot-water method. Soaking in ammoniacal copper carbonate solution gave partially favorable results, but copper sulphate the reverse. Experiments to ascertain if copper salts were injurious to vegetation were made with Bordeaux mixture, ammoniacal carbonate of copper, eau céleste, modified eau céleste, and ferrous sulphate, each in three different strengths. Injury to roots was most marked in the use of ammoniacal carbonate of copper. Rust of wheat is described and details are given of several treatments for prevention. Ammoniacal carbonate of copper and Bordeaux mixture were both used, but neither prevented rust (see Science, vol. XIX, Jan. 8, 1892, p. 23; Exp. Sta. Rec., vol. III, June, 1892, pp. 787–788). (J. F. J.)

1208. PEARSON, A. N. **Rust in wheat.** <Dept. Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 12–15.

Mentions the results of experiments on sixty-five plats of wheat made at Port Fairy on rust in wheat. Ferrous sulphate was the only substance that had any useful effect. It was recommended, however, to sow early and use rust-resisting varieties of grain. (J. F. J.)

1209. PEARSON, A. N., ET AL., COMMITTEE. **Report on Smith Ellis's scheme for preventing rust in wheat.** <Dept. Agr. Victoria, Bull. No. 14, Melbourne, Dec., 1891, pp. 119–125.

An adverse criticism of a plan advocated by Mr. Smith Ellis to prevent wheat rust, in which it is shown that the author is not conversant with the history of the fungus causing the disease, and concluding with the statement that he had failed to satisfy any of the committee that his so-called specific was in reality such. (J. F. J.)

1210. PICHI, P. **Alcuni esperimenti fisiopatologici sulla vite in relazione al parassitismo della peronospora. Nota prima.** <Nuovo Gior. Bot. Ital. (Bull. d. Soc.), vol. XXIII, Firenze, Apr. 6, 1891, pp. 361–366.

Reports on preliminary laboratory and field experiments planned with a view of ascertaining if copper sulphate may not be absorbed by the vine through the roots, and transferred to the leaves, where its presence will form an obstacle to the entrance of the hyphæ of the Peronospora. In laboratory experiment branches of healthy vines were kept in vases containing various strengths of copper sulphate solutions, together with proper controls. Both sets being treated with sowings of the zoospores of Peronospora, several of those in pure water were attacked by the parasite, while those in copper solutions were immune. In field experiments both solutions, of various strength, and the powdered copper sulphate were used, both being placed at the base of each vine, at the rate of from 2.5 grams to 1.25 kilograms per vine. The results of this treatment, while by no means proving an immunity from the disease caused by the presence of the sulphate, encourage the author in his hopes that such a method may be followed with success. Records the remarkable well-nigh impossible presence of crystals of copper sulphate in the leaves or branches maintained in a solution of the salt for twenty days. (D. G. F.)

1211. SMITH, F. C., SAGE, W., and ROBIN, A. B. **[Report of experiments on fungous diseases of fruit trees at Angaston.]** <South Australia Register, Nureootpa, Mar. 30, 1892.

Gives a summary of the results of experiments for apple and pear scab, shot-hole fungus of apricot, and peach leaf-curl. The fungicides used were ammoniacal copper carbonate solution, eau céleste, and Bordeaux mixture. Ammoniacal copper carbonate appeared to reduce apple scab. Bordeaux mixture gave the best results with shot-hole fungus of the apricot. None were useful in preventing pear scab, while all were effectual in treating peach leaf-curl. One sprayed peach tree that had for years been affected with curl was entirely free from it and produced 400 pounds of fruit. The knapsack pump is recommended for spraying. (J. F. J.)

1212. SHORE, ROBT. **Root knot on begonias.** <Am. Florist, vol. VII, Chicago and New York, Feb. 25, 1892, p. 626, $\frac{1}{5}$ col.

States that there is no cure for the disease, but that it can be prevented by baking the soil or sprinkling lime with it before planting. Recommends sprinkling with limewater every eight or ten days. (J. F. J.)

1213. SHUTT, F. T. **Report on the effect of solutions of copper sulphate (blue vitriol), iron sulphate (green vitriol), and agricultural bluestone on the vitality of seed wheat.** <Ann. Rept. Exp. Farms for 1890, Ottawa, 1891, pp. 146–148.

Gives details of treatment with solutions of varying strengths, both sulphate of iron and agricultural bluestone, this last (composed of one-third copper sulphate and two-thirds iron sulphate), seriously injuring the vitality when used in a solution of 1 pound to 8 gallons of water and immersed for thirty-six hours. Treated with the same quantity of sulphate of iron, the vitality was 96.5 as against 55.5 and 40 per cent for bluestone and sulphate of copper, respectively. Sprinkling the seed with the three solutions gave 99.0, 79.5, and 72.5 per cent, respectively. The result of the experiment shows that sulphate of iron did not materially affect the vitality of seed wheat, while copper sulphate and agricultural bluestone did. Loose smut appeared on all the plats treated. The seed was allowed to dry for thirteen days before being sown. (J. F. J.)

1214. Taft, L. R. **Report on the experiments made in 1889 in the treatment of apple scab in Michigan.** <Mich. Agr. Exp. Sta. Bull. No. 59, Agricultural College, Apr., 1890, pp. 30–42, figs. 6.

Gives details of series of experiments made with various fungicides, such as potassium sulphide, sodium hyposulphite, sulphur solution, copper carbonate and ammonia, and modified eau céleste. Modified eau céleste gave the best results (J. F. J.)

1215. Thaxter, R. **Further results from the application of fungicides to prevent the "spot" of quince (Entomosporium maculatum).** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 150–152, pl. 1.

States that two rows of trees treated with Bordeaux mixture yielded 71½ baskets of marketable fruit, while two rows treated with ammoniacal carbonate of copper in 1890, and precipitated carbonate of copper in 1891 yielded only 7 baskets. Five rows untreated for two years yielded only one basket. The balance above cost of treatment with Bordeaux mixture was $49.42 (see Exp. Sta. Rec., vol. III, June, 1892, pp. 770–771). (J. F. J.)

1216. Troop, James. **Treatment of powdery mildew and black rot [of grapes].** <Purdue Univ. Agr. Exp. Sta. Bull. No. 38, vol. III, La Fayette, Ind., Mar. 19, 1892, pp. 17–18.

States that powdery mildew of greenhouse grapes is controlled by potassium sulphide, 1 ounce to 5 gallons of water, and black rot by Bordeaux mixture, giving as a formula for the latter 12 pounds of sulphate of copper and 8 pounds of lime to 45 gallons of water (see Exp. Sta. Rec., vol. III, June, 1892, p. 781; also Prairie Farmer, vol. LXIV, June 11, 1892, p. 374). (J. F. J.)

1217. Veale, Henry. **Vitriol dressing for grain.** <Agr. Jour. Cape Colony, vol. IV, Cape Town, Aug. 27, 1891, p. 46, ½ col.

States that wheat treated for smut should not be steeped in vitriol, but in water for six hours, and then wet down with a solution of 2 ounces of vitriol to 1 gallon of water, afterwards drying the grain with slaked lime. Quotes from New Zealand School of Agriculture in regard to fungicides for smut. (J. F. J.)

1218. W. ——, N. J. de. **Steeping grain in vitriol.** <Agr. Jour. Cape Colony, Cape Town, vol. IV, Oct. 22, 1891, p. 95, ¼ col.

Concludes that failure of seed to grow after immersion in blue stone solution was due to swollen condition of seed. Untreated seed germinates in less time than treated. (J. F. J.)

1219. Willis, J. J. **Bordeaux mixture as a preventive of the potato blight.** <Gard. Chron., 3d ser., vol. XI, Jan. 23, 1892, London, p. 106, 1 col.

Mentions the widespread use in the United States of Bordeaux mixture on grapes and says that its use against potato rot was suggested by the similarity of the fungus to that causing the brown rot of grapes. Gives an account of experiments in 1890 conducted by the Rhode Island State Agricultural Experiment Station on the use of Bordeaux mixture on potatoes. The results were that three sprayings increased the yield 10 per cent and five sprayings 34 per cent, the increased yield being due to the larger size of the tubers. (M. B. W.)

1220. Woolen, L. R. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Feb. 11, 1892, p. 574, $\frac{1}{10}$ col.

Gives as a remedy the use of air-slaked lime or even pouring strong limewater on the plants. (J. F. J.)

1221. Z——, X. Y. **The modern remedies for the potato disease.** <Gard. Chron., 3d ser., vol. X, London, Dec. 19, 1891, p. 742, ⅙ col.

Thinks there is as yet no remedy for the disease. (M. B. W.)

1222. Zirngiehel, Denys. **The violet disease.** <Am. Florist, vol. VII, Chicago and New York, Feb. 4, 1892, p. 552, ⅓ col.

States that Italians combat the disease by use of Bordeaux mixture. (J. F. J.)

(See also Nos. 1010, 1021, 1035, 1037, 1045, 1047, 1056, 1058, 1059, 1065, 1068, 1070, 1071, 1072, 1078, 1079, 1080, 1081, 1083, 1084, 1085, 1086, 1088, 1089, 1090, 1093, 1095, 1096, 1100, 1105, 1106, 1107, 1108, 1109, 1111, 1113, 1114, 1116, 1117, 1121, 1129, 1130, 1131, 1133, 1134, 1135, 1136, 1137, 1138, 1139.)

E.—PHYSIOLOGY, BIOLOGY, AND GEOGRAPHICAL DISTRIBUTION.

1223. [Anon.] **Hetorœcismal fungi.** <Gard. Chron., 3d ser., vol. IX, London, May 30, 1891, p. 683, ⅛ col.

Notes the statement by Plowright that he had produced *Cœoma laricis* on the larch by infecting the tree with the teleutospores of *Melampsora betulinæ* from birch, and that Dr. Franzschel had found in Russia *Puccinia digraphidis* Soppitt growing on *Phalaris arundinacea* in vicinity of *Æcidium convallariæ*, and *P. agrostidis* on *Agrostis vulgaris* in vicinity of *Æcidium aquiligæ*. (J. F. J.)

1224. [ANON.] **[Occurrence of Sphærotheca lanestris in Mississippi.]** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Oct. 16, 1891, p. 297.

Notes that this species, previously supposed to be confined to *Quercus agrifolia*, has been found by S. M. Tracy on various species of oak in Mississippi and by Atkinson in Alabama. (J. F. J.)

1225. [ANON.] **[Oöspores in Phytophthora infestans.]** <Gard. and Forest, vol. III, New York, Sept. 10, 1890, p. 448, ¼ col.

Calls attention to paper by Smorawski in which it is stated that mycelium of the potato-rot fungus produced conidia and also oögonia-like bodies, regarded by him as antheridia. The reviewer does not consider that Smorawski's idea is fully proven by his investigations. (J. F. J.)

1226. [BEACH, S. A.] **Influence of copper compounds in soils upon vegetation.** <N. Y. State Agr. Exp. Sta. Bull. No. 41, n. ser., Geneva, Apr., 1892, pp. 35–43, figs. 3, charts 7.

Gives details of experiments with peas, tomatoes, and wheat planted in soils containing 2 and 5 per cent of copper sulphate, mentioning the differences in germination, foliage, period of maturity, number and weight of seed, root system, etc. The results point to the fact that the presence of copper in the soil in large quantities is injurious to plant growth. (J. F. J.)

1227. COBB, N. A. **Contributions to an economic knowledge of Australian rusts (Uredineæ).** <Agr. Gaz. N. S. Wales, vol. III, Sydney, Mar., 1892, pp. 181–212, figs. 13.

A continuation of an article published in some previous numbers on the subject, detailing what has been found out concerning wheat rust, discussing the wheat, soil, rust, and weather; also detailing the results of an examination of rust-resisting varieties of wheat in the structure of the cuticle, the tensile strength of the leaves, and the presence of stomata. Appendices contain measurements of the thickness of wheat leaves, width of the same, the tensile strength, and notes on the number of stomata observed. (J. F. J.)

1228. CONN, H. W. **Some uses of bacteria.** <Science, vol. XIX, New York, May 6, 1892, pp. 258–263.

A popular description of the good results arising from the presence of bacteria, especially as related to farming industries. Points out the agency of the organisms in the production of butter, cheese, beer, vinegar, etc. (J. F. J.)

1229. COOKE, M. C. **Ceylon in Australia.** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 29–30.

After stating that certain species of fungi have a world-wide distribution, the author says that other species occur only in countries far apart. As an example of this he points out that many of the species of fungi characteristic of Ceylon occur also in Australia. A number of species are cited, these being mostly large forms, such as Polyporei, Agaricini, etc. (M. B. W.)

1230. DETMERS, FREDA. **A fungous enemy of plant lice.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 14–16.

Describes *Empusa aphidis* as affecting various species of Aphis occurring on lettuce, radishes, chrysanthemums, etc. Believes the disease would be economically valuable if it could be introduced among plant lice affecting grain fields. (J. F. J.)

1231. DUFOUR, J. **Einige Versuche mit Botrytis tenella zur Bekämpfung der Maikäferlarven.** <Zeitsch. f. Pflanzenkrank., vol. II, Stuttgart, 1892, pp. 2–9.

Several experiments are described to show the possibility of infesting larvæ of the May beetle with Botrytis. The fungus was taken from pure cultures upon potato and from dead larvæ which had been killed by the fungus. The result shows that infection can take place from living larvæ, but the spreading of the infection, especially in the field experiments, was less than stated by French authors. Many larvæ were observed to be able to resist the infection for the three months during which the experiments were made. (T. H.)

1232. DUGGAR, B. M. **Germination of the teleutospores of Ravenelia cassiæcola.** <Bot. Gaz., vol. XVII, Bloomington, Ind., May 17, 1892, pp. 144–148, pl. 2.

Describes the general characters of the teleutospores and their germination and growth. (J. F. J.)

1233. [HUDSON, A. S.] **Force of mushroom growth.** <Pop. Sci. Monthly, vol. XXXIX, New York, Aug., 1891, p. 575, ½ col.

Refers to growth of mushrooms through a cement, asphalt, and gravel floor in a stable. One specimen came from an inch and a quarter below the surface. Where a second forced its way up the fragment of cement displaced by it was found a foot away. (J. F. J.)

1234. KOBERT. **Ueber Giftpilze.** <Sitzungsber. d. Natur. Ges. d. Univ. Dorpat, vol. IX, Dorpat, 1892, pp. 535–554.

The author divides the cases of poisoning according to the various fungi which cause it, but includes merely those cases that are known from the Baltic Provinces. One group comprises poisoning by fungi, which contain muscarin, e. g, *Agaricus muscarius* and *Boletus luridus;* other cases are due to the milky juice of the species of *Lactarius* or of *Helvella*, which contains an acid named helvellic acid. The fourth group includes such as are due to *Amanita phalloides*, one of the most dangerous, since it looks very much like the edible *Agaricus campestris*. The author discusses at length the effect and the character of the diseases (see review by Em. Bourquelot, "Matières toxiques contenues dans les champignons vénéneux," in Bull. Soc. Mycol. France, vol. XIII, Paris, Mar. 31, 1892, p. 40). (T. H.)

1235. SNOW, F. H. **Contagious diseases of the chinch bug.** <First Ann. Rept. Direc. Exp. Sta. Univ. Kan. for 1891, Topeka, Apr., 1892, p. 230, pl. 4, 1 map.

A detailed account of experiments conducted on diseases of the chinch bug, giving the laboratory observations and experiments, reports of field agents, estimates of value of crops saved, statement of effect of meteorological conditions, history of microphytous diseases of the bug, and a bibliography. The two fungi mainly relied upon, though not in pure cultures, are *Sporotrichum globuliferum* and *Empusa aphidis*. The mode of growth of these is described. Pure cultures of the former did not produce the disease in inoculated chinch bugs (p. 27). It was not possible to obtain pure cultures of *Empusa*, and no attempts at inoculation were made. A bacterial disease caused by *Micrococcus insectorum* was present and was communicated from infected to healthy bugs. The amount saved to 482 farmers is estimated in cash to be $87,244.10, and in the same ratio to the 1,068 successful experiments, $193,308. Pages 192–217 are occupied by a history of the diseases of the bug in the United States, therein are given extracts from many papers (see Exp. Sta. Rec., vol. III, June, 1892, pp. 833–835). (J. F. J.)

1236. WARD, H. M. **The ginger-beer plant and the organisms composing it: A contribution to the study of fermentation yeasts and bacteria.** <Proc. Roy. Soc., London, vol. L, Jan. 20, 1892, pp. 261–265. · Phil. Trans. Roy. Soc., London, vol. CLXXXIII, Sept. 26, 1892, pp. 125–197, pl. 6, figs. 6.

The author has investigated a remarkable compound organism concerned in the fermentation of home-made ginger beer, and the article is a brief notice of the work. The organism occurs as jelly-like yellowish white masses aggregated into brain-like clumps. It resembles the so-called *Kephir* yeast, but is not identical with it. The masses consist of a symbiotic association of specific yeasts and bacteria, morphologically comparable to lichens. Besides the essential species, other species of yeasts, bacteria, and mold fungi are casually associated. The various organisms were isolated by culture methods. The essential organisms are a yeast, *Saccharomyces pyriformis* n. sp., and a bacterium, *B, vermiforme* n. sp. Both are described. Two other forms are always found, *Mycoderma cerevisiæ* and *Bacterium aceti*. The author has reconstructed the "ginger-beer plant" by mixing pure cultures of the two first-named plants. The action of plants thus synthetically produced is the same as the original, while the action of the bacteria alone on a saccharine medium differs from that exerted when it is associated with the yeast and from that exerted by the latter alone. (M. B. W.)

1237. WEBER, H. A. **Analyses of mushrooms.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, p. 12.

Gives a table of analyses of mushrooms, morels, and white truffles. (J. F. J.)

(See also No. 1117.)

F.—MORPHOLOGY AND CLASSIFICATION OF FUNGI.

I.—GENERAL WORKS.

1238. [ANON.] **Memorabilia.** <Grev., vol. XX, No. 93, Sept., 1891, London, p. 22.

Six species not in Saccardo's Sylloge, *Strobilomyces polypyramis* Hook., *Colletotrichum microspermum* Corda, *Zasmidium cellare* Fr., *Alytosporium fulvum* Fr., *A. croceum* Schw., and *A. peteridicola* Schw. *Triposporium cristatum* Patouillard is a synonym of *Spegazzinia tessarthra* (B. & C.). (M. B. W.)

1239. BAILEY, F. M. **Botany. Contributions to the Queensland flora: Fungi.** <Queensland Dept. of Agr. Bull. No. 7, Brisbane, Mar., 1891, pp. 33–36.

Contains descriptions of species of fungi new to the Queensland flora. (J. F. J.)

1240. BAILEY, F. M. **Contributions to the Queensland flora.** <Queensland Dept. of Agr. Bull. No. 18, Brisbane, May, 1892, pp. 36.

On pp. 34–36 are given names of species of fungi new to the colony. No new species are described. (J. F. J.)

1241. BAILEY, F. M. **[Report of the colonial botanist.]** <Ann. Rept. Dept. Agr. Queensland for 1890–'91, Brisbane, 1891, pp. 40–48.

Mentions three species of fungi found in the Bellenden-Ker expedition and five blights observed to have injured plants during the year. (J. F. J.)

1242. BERLESE, A. N. **Icones fungorum ad usum sylloges saccardianæ adcomodatæ. Fasc. I–III,** pp. 1–118, pl. I–CXXIII, Patavii, 1890–'92.

Descriptions and illustrations of fungi given by Saccardo, with references to literature and descriptions of new species as follows: *Lophiostoma parvulum, L. nigricans, Lophiopsis* n. gen., with *L. nuculoides* (Rehm) as the type; *Titania* n. gen., with *T. berkleyi* proposed for *Diatrype titan* B. et Br.; *Passeriniella* n. gen., with *P. dichroa* (Pass) as type; *Leptosphæria socialis*, in stems of *Asparagus officinalis; L. kunzeana* in stems of *Typha latifolia; L. ellisiana* in dead stems of *Œnothera biennis*, proposed for *L. subconica* Ellis; *L. hanzslinskyana* in stems of grasses; *L. rhopalispora; L. acutiuscula*, proposed for *L. acuta* Rehm; *Leptosphæriopsis* n. gen., with *Lept. ophioboloides* Sacc. as type. *Gnomoniopsis* n. gen., with *G. chamæmori* (Fr.) as type; *Winterella* n. gen., with *W. tuberculigera* (Ell. and Ev.) as type. (J. F. J.)

1243. COOKE, M. C. **Australian fungi.** <Grev., vol. XX, No. 93, Sept., 1891, London, pp. 4–7.

Gives descriptions of the following new species: *Strobilomyces ligulatus, S. fasciculatus, Hypocrella axillaris*, on grasses; *Phyllachora maculata* on *Eucalyptus; Dothidella inæqualis* on *Eucalyptus; Montagnella rugulosa* on *Eucalyptus; Physalospora microsticta; Trabutia parvicapsa* on Acacia *Anthostomella lepidospermæ* on *Lepidosperma; Sphærella crypta* on *Eucalyptus; Dimerosporium parvulum* on *Trema aspera; Asteromella epitrema* on *Trema aspera; Piggotia subtellata* on *Eucalyptus; Leptothyrium aristatum* on *Eucalyptus; Stagonospora orbicularis* on *Eucalyptus; Stilbospora foliorum* on *Eucalyptus;* and *Strumella patelloidea*. (Cont. from vol. XIX, p. 92. See No. 555.) (M. B. W.)

1244. COOKE, M. C. **Australian fungi. Supplement to handbook.** <Grev., vol. XXI, London, Dec., 1892, pp. 35–39.

The following new species are described, all but three (as noted) described by Cke. and Mass.: *Agaricus (Lepiota) membranaceus, A. (Clitopilus) cyathoideus, A. (Hebeloma) griseus, A. (Tubaria) strigipes, A. (Hypholoma) discretus, Bolbitius candidus, Marasmius subroseus, Lenzites bifasciatus, Polyporus (Ovini) mylittæ, Dædalea illudens, Hydnum (Resup.) calcareum, Stereum pannosum, Cyphella longipes, Stephensia arenivaga, Diploderma sabulosum, Sphærella goodiæfolia* Cke., on leaves of *Goodia latifolia; Oöspora rutilans, Monotospora fasciculata, Cercospora glycines* Cke., on leaves of *Glycine clandestina; Hymenula eucalypti* on leaves of *Eucalyptus;* and *Phyllosticta prostantheræ* Cke., on leaves of *Prostanthera lasianthos*. (J. F. J.)

1245. COOKE, M. C. **Exotic fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 15–16.

Describes these new species of fungi: *Cordyceps speerigini* Mass. on ant (*Formica*), *Sphærostilbe macowani* (Korb.), and *Uredo* (*Uromyces* (?)) *aloes*. (M. B. W.)

1246. COOKE, M. C. **Mushrooms and toadstools.** <Grev., vol. XIX, London, March, 1891, pp. 83–84.

Discusses the numbers of edible and poisonous British species of fungi. (M. B. W.)

1247. COOKE, M. C. **New British fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 8.

Describes *Kalmusia stromatica* Cke. & Mass., *Coryneum cammelliæ* on *Camellia, Ramularia petuniæ* on Petunia. (M. B. W.)

1248. COOKE, M. C. **New Zealand fungi.** <Grev., vol. XXI, London, Sept., 1892, p. 1.

Describes new species as follows: *Rhizopogon violaceus* Cke. & Mass. on ground, *Chromosporium pallescens* Cke. & Mass. among mosses, *Camarosporium solandri* on twigs of *Fagus solandri*. (J. F. J.)

1249. [ELLIS, J. B., AND ANDERSON, F. W.] **New species of Montana fungi.** <Bot. Gaz., vol. XVI, Crawfordsville, Ind., Mar. 16, 1891, pp. 85–86, pl. 1.

Gives description of plate illustrating article in February number, the two species illustrated being *Sporidesmium sorisporioides* E. & A. and *Æcidium liatridis* E. & A. (see No. 257). (J. F. J.)

1250. M[ASSEE,] G. **Memorabilia.** <Grev., vol. XIX, London, June, 1891, p. 108.

Notes that *Thelephora suffulta* B. & Br., *T. retiformis* B. & C., and *T. reticulata* B. & C. are all forms of *T. pedicellata* L. Notices that a book on "British Edible Fungi," by M. C. Cooke, is in press. Also a note on *Emericella variecolor* B. & Br. and *Inzengacea erythospora* Borzi, the latter having been described by Harkness through mistake as a new genus, *Thelospora*. (M. B. W.)

1251. ROSTRUP, E. **Tillæg til "Grœnlands Svampe, 1888."** <Meddelelser om Grœnland, vol. III, Copenhagen, 1891, pp. 593–643.

Enumeration of fungi collected in Greenland since 1888. Some new species are described. *Hymenomycetes* 58 sp., new—*Cyphella lateritia; Gasteromycetes* 2 sp.; *Tremellaceæ* 5 sp.; *Ustilagineæ* 4 sp.; *Uredinaceæ* 3 sp.; *Taphrinaceæ* 1 sp.; *Discomycetes* 46 sp., new, *Cudionella fructigena, Neottiella vitellina, Sclerotinia vahliana, Phialea macrospora, Mollisia alpina, Cenangella hartzii, Godronia juniperi, Phacidium polygoni, Trochila rhodiolæ, Pseudopeziza axillaris, Glonium betulinum; Pyrenomycetes* 57 sp., new, *Læstadia alchemillæ, L. potentillæ, Apiospora rosenvingei, Coleroa oxyriæ, Leptosphæria brachysca, Melanomma sali*

1251. Rostrup, E.—Continued.

cinum, *Acanthostigma alni*, *Pleospora vitrea; Sphæropsideæ* 23 sp., new, *Phyllosticta ledi*, *Phoma hieracii*, *Septoria pyrolata*, *Dinemasporium galbulicola; Gymnomycetes* (*Melanconieæ*) 13 sp., new, *Melanostroma sorbi; Hyphomycetes* 17 sp., new, *Cercosporella oxyriæ*, *Heterosporium stenhammariæ*, *Dendrodochium betulinum; Zygomycetes* 1 sp.; *Entomophthoraceæ* 1 sp.; *Saprolegniaceæ* 1 sp.; *Peronosporaceæ* 1 sp.; *Chytridiaceæ* 1 sp., new, *Physoderma hippuridis*. Of sterile mycelia 8 species were found, of which *Sclerotium baccarum* is new. (T. H.)

1252. Trail, J. W. H. **Report for 1890 on fungi of east of Scotland.** <Scottish Naturalist, No. 31, Perth, Jan., 1891, pp. 31–35.

Lists of fungi from the Provinces of Forth, Tay, and Dee, comprising *Uredineæ*, *Ustilagineæ*, *Pyrenomycetes*, *Ascomycetes*, *Perisporiaceæ*, *Peronosporeæ*, *Hyphomycetes*, *Discomycetes*, and *Gastromycetes*, with host plants, dates, and brief notes on some of the species. (M. B. W.)

1253. Whymper, Edw. **Travels amongst the great Andes of the Equator, with maps and illustrations.** 8vo. New York, 1892, pp. xxiv, 456.

On page 199 notes the occurrence on Antisana, at an elevation of 13,000 feet, of *Omphalia umbellifera* Fr. and *Psilocybe* sp. On pages 209 and 352 mentions finding of *Cantharellus whymperi* Massee & Murray on Pichincha at an elevation of 15,300 feet. (J. F. J.)

III.—OOMYCETES.

1254. Williams, Thos. A. **Notes on Peronosporaceæ.** <Bull. Torrey Bot. Club, vol. xix, New York, Mar. 5, 1892, pp. 81–84.

Gives notes on species of *Peronospora*, *Sclerospora*, *Plasmopara*, and *Cystopus*, found in the vicinity of Brookings, S. Dak. A table is also given showing the rainfall during the summer months of 1890 and 1891. (J. F. J.)

V.—BASIDIOMYCETES.

1255. [Anon.] **[Edible Agaricini.]** <Bot. Gaz., vol. xvi, Crawfordsville, Ind., May 16, 1891, p. 157.

Notes that of the 1,400 species of Agaricini in Great Britain 134 are edible, 30 are poisonous, and of 516 nothing is known. The balance are too small, too tough, or too rare to be of value. (J. F. J.)

1256. [Anon.] **Notes on Tremellini.** <Grev., vol. xx, No. 93, London, Sept., 1891, p. 15.

List of species of *Dacryomyces* and *Peziza*, not in Saccardo's Sylloge, and descriptions as new of *Auricularia corium* Berk. in Herb., and *A. epitrichia* Berk. in Herb. *Tremella lilacina* Mull. is mentioned as being the same as *T. sarcoides*. (M. B. W.)

1257. [Anon.] **Revue horticole.** <Nouv. Ann. Soc. Hort. Gironde, No. 55, Bordeaux, Sept., 1891, pp. 152–153.

Contains a note on the importance of mushroom culture in the environs of Paris, with brief account of manner of growing. (M. B. W.)

1258. [Anon.] **Trametes trogii Berk.** <Grev., vol. xxi, London, Dec., 1892, pp. 45–46.

Refers to paper in Jour. de Bot. by M. P. Hariot in which it is concluded that *Trametes hispida* and *T. trogii* are identical. States that this conclusion is erroneous, inasmuch as Hariot had not seen the type specimen of *T. trogii*. Gives a description of the specimen, and says it is quite distinct from *T. hispida*. (J. F. J.)

1259. Bourquelot, Em. **Le "toboshi," champignon du Japon analogue à l'Agaric blanc des pharmacies.** <Bull. Soc. Mycol. France, vol. viii, Paris, Mar. 31, 1892, p. 39.

The inhabitants of Yeso designate under the name "toboshi" a mushroom that grows on trunks of larch (*Larix leptolepis*). This is a species of *Polyporus*, about the size of one's fist. They prepare of it a remedy against the sweating of phthisic patients. It contains a resin and an acid, the last of which is not, however, identical with agaric acid. (T. H.)

1260. Boudier and Patouillard. **Note sur une nouvelle Clavaire de France.** <Bull. Soc. Mycol. France, vol. viii, May 22, 1892, pp. 41–43, pl. 1.

Describes *Clavaria geoglossoides* Boud. et Pat. as a new species. It was found growing together with *C. inæqualis* and *C. similis*. According to the description and the figures, it shows a striking resemblance to a *Geoglossum*, but has the principal characters in common with the genus *Clavaria*. (T. H.)

1261. BRITZELMAYR, M. **Das Genus Cortinarius.** <Bot. Centralbl., vol. LI, Cassel, June 28, July 12, 1892, pp. 1–9, 33–42.

Among the characters which seem to be constant for this genus is the manner in which the lamellæ are attached to the pileus, as well as the color, the shape, and the size of the spores. The author enumerates the species arranged according to the system of Fries, and adds to each the size of the spores, besides giving descriptions of several of his own species. The following new species are described: *Cortinarius largiusculus, C. disputabilis, C. percognitus, C. extricabilis, C. vesperus, C. politulus, C. opimatus, C. albidocyaneus, C. fusco-violaceus, C. collocandus, C. effictus, C. submyrtillinus, C. melleifolius, C. subinfucatus, C. abiegnus, C. inurbanus, C. fulvo-cinnamomeus, C. fagineti, C. subcarnosus, C. assumptus, C. quæsitus, C. divulgatus, C. illepidus, C. luxuriatus, C. benevalens, C. multivagus, C. fistularis, C. blandulus.* Gives also several critical notes on the species named by Fries, which are enumerated in the list. (T. H.)

1262. COOKE, M. C. **British Tremellineæ.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 16–22.

A revision of the British species of this family, with characterization of the family, subfamilies, genera, and species. (M. B. W.)

1263. COOKE, M. C. **New British fungi.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 25.

Descriptions of *Agaricus* (*Flammula*) *aldridgii* Massee and *Paxillus subinvolutus* Batsch. (M. B. W.)

1264. COOKE, M. C. **Notes on Clavariei.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 10–11.

Critical notes on several species of *Clavaria, Calocera*, and *Lachnocladium*, with description of *Clavaria muelleri, C. tasmania, Lachnocladium kurzii* Berk. in Herb. *L. rubiginosum* Berk. & Curt. in Herb., *L. hookeri* Berk., and *Acurtis giganteum* are said not to be good species. (M. B. W.)

1265. COOKE, M. C. **Notes on Thelephoriæ.** <Grev., vol. XX, No. 93, London, Sept., 1891, pp. 11–13.

A list of species, with notes and locations, of *Hymenochæte, Peniophora, Corticium*, and *Conophora*. *Hymenochæte scrufosa* Mass. in Herb., *Corticium compactum* B. & C. in Herb., and *C. nigrescens* B. & C. in Herb. are described as new. (M. B. W.)

1266. COOKE, M. C. **Species of Cyphella.** <Grev., vol. XX, No. 93, London, Sept., 1891, p. 9.

A list of twelve species not included by Saccardo in his Sylloge, with descriptions of four new species: *C. fumosa* on Gladiolus, *C. fuscospora* Currey in Herb., *C. australiensis*, and *C. texensis* Berk. & Curt. in Herb. (M. B. W.)

1267. DELOGNE, C. H. **Les Boteles, analyse des espèces de Belgique et des pays voisins, avec indication des propriétés comestibles ou vénéneuses.** <Bull. Soc. Belg. de Micr., t. XVII, Brussels, Feb., 1891, pp. 70–87.

Gives the characters of the genera *Boletinus, Boletus, Girodon, Strobilomyces*, and *Phylloporus*, with descriptions of the species. The article has special reference to distinguishing the poisonous and edible species. (M. B. W.)

1268. MORGAN, A. P. **Myriostoma coliforme, Dicks, in Florida.** <Am. Naturalist, vol. XXVI, Philadelphia, Apr., 1892, pp. 341–342.

Notes the occurrence of this species as found by L. M. Underwood near Eldorado, Fla. Describes the internal structure, concluding that probably *Geaster columnatus* is the same species. (J. F. J.)

1269. MORGAN, A. P. **North American fungi, fifth paper. The Gastromycetes.** <Jour. Cin. Soc. Nat. Hist., vol. XIV, Cincinnati, Oct., 1891 to Jan., 1892 [Mar. 5, 1892], pp. 141–148, pl. 1.

Describes new genera and species, as follows: *Bovistella* n. gen., *Catastoma* n. gen.; *C. pedicellatum, Bovista montana, B. minor*, and gives besides descriptions of old species belonging to various genera. (J. F. J.)

1270. TOWNSHEND, N. S. **Mushrooms for the table.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 6–8.

Describes briefly the appearance of various species of edible mushrooms (Agaricus, Morchella, truffle, and puff ball), giving directions for cooking, and a short statement of how to distinguish edible from poisonous species. (J. F. J.)

1271. TURNER, W. S. **Mushroom culture.** <Jour. Columbus Hort. Soc., vol. VII, Columbus, Ohio, Mar., 1892, pp. 8–10.

Gives directions for preparing beds for mushroom cultivation, with an estimate of the probable money value of the product. (J. F. J.)

VI.—UREDINEÆ.

1272. DETMERS, FREDA. **A preliminary list of the rusts of Ohio.** <Ohio Agr. Exp. Sta. Bull. No. 44, Columbus, Sept., 1892, pp. 133–140.

Gives a list of species of *Uromyces*, *Puccinia*, *Phragmidium*, *Gymnosporangium*, *Melampsora*, *Coleosporium*, *Cæoma*, and *Æcidium*, together with notes on hosts and localities. (J. F. J.)

1273. DIETEL, P. **Zur Beurtheilung der Gattung Diorchidium.** <Ber. d. Deutsch. Bot. Ges., vol. x, Heft 2, Berlin, Mar. 23, 1892, pp. 57–63, figs. 2.

A revision of the genus *Diorchidium* and a discussion of several of the species formerly described by Magnus. The author's opinion is that while the genus *Diorchidium* is probably not tenable, because there are transition fo ns into *Puccinia*, he would nevertheless retain it for the present, because the distinction between other genera (*Uromyces* and *Puccinia*) are quite as artificial. For the present, therefore, he would include in *Diorchidium* species in which the majority of the spores have the septum perpendicular upon the pedicel. The genus *Sphenospora* is, however, established by the author for *Diorchidium pallidum*, much on account of the differences in the development of the spores. It is characterized by having no endospore and consequently no germ pores are formed before germination. Only when germination has taken place are the places indicated through which the contents of the spore has come out. (T. H.)

1274. KLEBAHN, H. **Bemerkungen über Gymnosporangium confusum Plowr. und G. sabinæ (Dicks.).** <Zeitsch. f. Pflauzenkrank., vol. II, Heft 2, Stuttgart, 1892, pp. 94–95.

The author states the discovery of *Gymnosporangium confusum* in the vicinity of Bremen. It has been shown by culture that this fungus developed abundant æcidia upon *Cratægus oxyacantha*. According to Dr. Focke, this fungus has existed near Bremen since 1860. There had been planted a number of varieties of *Cratægus* that were badly injured by a *Rœstelia*, while numerous pear trees in the same garden did not show any sign of fungous disease. (T. H.)

1275. KLEBAHN, H. **Zur Kenntniss der Schmarotzer-Pilze Bremens und Nordwestdeutschlands, Zweiter Beitrag.** <Abhand. des Natur. Ver. Bremen, vol. XII, Bremen, May, 1892, pp. 361–376.

Ninty-six species of fungi are known from the vicinity of Bremen, among which *Puccinia* is represented by 43, *Uromyces* 11, *Melampsora* 9, and some others scarcely at all. The paper contains remarks upon some of the important forms, such as *Lagenidium*, *Syncytiorum* n. sp. *ad interim* of the family *Ancylistaceæ*. This fungus is merely known in the sporangium form and occurs in *Œdogonium boscii*. A new variety of *Puccinia perplexans* is described, namely, *arrhenatheri*, found upon *Arrhenatherum elatius* and a variety, *corticicola*, of *Phragmidium rubi*. *Peridermium pini* is rare in the northwestern parts of Germany, and the author mentions that the teleutosporic form is still unknown. The spermogonia of *Peridermium* showed some differences when the fungus has been taken from *Pinus strobus* or *P. sylvestris*. Those of the last do not cause any swelling of the branches and they are only visible when the bark has been removed. They then show as yellow spots, but the microscopic structure is almost the same as in *P. strobi* The peculiar odor observed in the spermogonia of *P. strobi* was not found in *P. pini*. (T. H.)

1276. THAXTER, R. **The Connecticut species of Gymnosporangium (cedar apples).** <Ann. Rept. Conn. Agr. Exp. Sta. for 1891, New Haven, 1892, pp. 161–165.

Discusses the connection between cedar apples and rust of fruit trees. Mentions species found in Connecticut and describes development. Notes experiments to determine the life history of the "bird's-nest" form and describes as a new species *Gymnosporangium nidus-avis* (see No. 310). (J. F. J.)

(See also No. 1227.)

VIII.—ASCOMYCETES.

a.—Gymnoasci.

1277. BOUDIER, EM. **Description de deux nouvelles espèces de Gymnoascus de France.** <Bull. Soc. Mycol. France, vol. VIII, May 22, 1892, pp. 43–45, pl. 1.

Gymnoascus umbrinus and *G. bourquıloti* are described and figured as new. (T. H.)

b.—Perisporiaceæ.

1278. BOMMER, CH. **Un champignon pyrénomycète se développant sur le test des Balanes.** <Bull. Soc. Belg. de Micr., t. XVII, Brussels, May 30, 1891, pp. 151–154.

Describes *Pharacidiea marina*, which is found growing on living *Balanus balanoides*. The most remarkable thing about the species is the symbiotic relation between its mycelium and unicellular algæ (Chroococcaceæ) which the author has described. (M. B. W.)

1279. Chatin, A. **Nouvelle contribution à l'histoire de la truffe (Tirmania cambonii). Terfas du Sud algérien.** <Comp. Rend., vol. cxiv, Paris, June 13, 1892, pp. 1397-1399.

Tirmania cambonii is a new species from Algeria, closely related to *T. africana*, but differing from it by its finely veined flesh and the larger asci and spores. The spores also contain an oily matter in large quantity. The following truffles have so far been observed in Algeria: *Terfezia leonis*, *T. boudieri*, *T. claveryi*, *Tirmania africana*, and *T. cambonii*. (T. H.)

c.—Sphæriaceæ.

1280. Atkinson, Geo. F. **On the structure and dimorphism of Hypocrea tuberiformis.** <Proc. Am. Asso. Adv. Sci. for 1891, vol. xl, Salem, Mass., July, 1892, p. 320.

Abstract giving a statement of various papers published on the subject. Notes that both perfect and conidial stages have been found by the author in Alabama. These are described. The opinion is expressed that the species should be placed, pending further study, in the genus *Hypocrella*, and be known as *Hypocrella tuberiformis* (B. & Rav.) (see No. 611). (J. F. J.)

1281. Baumann, E. **Ueber Cordyceps robertsii Berk.** <Ber. d. Schweizer. Bot. Ges., vol. ii, Basel and Genf, 1892, p. 70.

This fungus was parasitic upon the pupa of *Hepialus virescens* from New Zealand. (T. H.)

d.—Discomycetes.

1282. [Anon.] **Morels.** <Gard. Chron., 3d ser., vol. ix, London, Apr. 18. 1891, pp. 504-506, fig. 1.

Figure of the fungus. (M. B. W.)

1283. Boudier, Em. **Note sur les Morchella bohemica Kromb. et voisins.** <Bull. Soc. Mycol. France, vol. viii, Paris, July 21, 1892, pp. 141-144.

Morchella bohemica was first described and figured by Krombholtz in 1828; it was referred to the genus *Morchella*. Other authors placed the species under the genus *Verpa*, but Boudier prefers to arrange it as a subgenus of *Verpa*, viz. *Ptychoverpa*. There are some differences from the true *Verpæ*, which consist in the morchelloid aspect of the fungus, the few-spored thecæ, and the size and shape of the spores. *Morchella bispora* and *M. gigaspora* are probably not distinct species, but rather represent forms of the above. (T. H.)

1284. Phillips, Wm. **New Discomycetes from Orkney.** <Scottish Naturalist, No. 32, Apr., 1891, Perth, pp. 89-91.

Describes the following new species: *Hymenoscypha symphoricarpi*, *H.* (*Niptera*) *cinerella* Sacc., forma *cæspitosa*, *Lachnella orbicularis*, *L. brunneociliata*, *L.* (*Helotiella*) *laburni*, and *Cenangium empetri*, with descriptions of two other species. (J. F. J.)

IX.—IMPERFECT AND UNCLASSIFIED FORMS.

a.—Hyphomycetes and Stilbeæ.

1285. Morgan, A. P. **Two new genera of Hyphomycetes.** <Bot. Gaz., vol. xvii, Bloomington, Ind., June 15, 1892, pp. 190-192, figs. 2.

Describes *Cylindrocladium* n. gen. and *C. scorparium* n. sp. on pod of *Gleditschia triacanthos*, and *Synthetospora* n. gen. and *S. electa* n. sp. on *Peziza* sp. (J. F. J.)

b.—Sphæropsideæ and Melanconieæ.

1286. [Anon.] [**Greeneria fuliginea.**] <Bot. Gaz., vol. xvi, Crawfordsville, Ind., Feb. 15, 1891, p. 60.

Notes change of position in classification of the species. According to Cavara it belongs with the *Melanconieæ* instead of *Sphæropsideæ*, and should be called *Melanconium fuligineum* (Scrib. & Viala) Cavara. Specific characters are given. (J. F. J.)

G.—MORPHOLOGY AND CLASSIFICATION OF BACTERIA.

1287. Ball, V. M. **Essentials of bacteriology; being a concise and systematic introduction to the study of microorganisms for the use of students and practitioners.** Philadelphia, 1891, pp. 159, figs. 77.

Discusses the classification of bacteria and gives an outline of the various schemes of classification. Notes the various forms assumed and the effect produced by bacteria on living organisms. Gives methods of examinations and of staining, and formulæ for various reagents; methods of culture; descriptions of various media employed; modes of inoculation, growth, and appearance of colonies; special modes of cultivation; and effects of bacteria on animals. In part two, discusses special bacteriology, describing diseases due to the organisms, and in appendix gives an account of yeasts and moulds, with methods of examination. (J. F. J.)

1288. Ward, H. Marshall. **On the characters or marks employed for classifying the Schizomycetes.** <Ann. of Bot., vol. VI, London, Apr., 1892, pp. 103–144.

Gives a brief outline of the history of the classification of bacteria, presenting in tabular form the various schemes proposed, as follows: Cohn in 1875, Winter in 1881, Van Tieghem in 1884, Flügge in 1886, Hueppe in 1886 and later, Zopf in 1885, De Toni in 1889, Miquel in 1891, and Woodhead in 1891. Each of these is briefly discussed. Suggests in conclusion that in the future notes be made on habitat, nutrient medium, gaseous environment, temperature, morphology and life history, special behavior, and pathogenic effects. (J. F. J.)

(See also Nos. 1228, 1236.)

J.—TECHNIQUE.

1289. Arthur, J. C. **Cultivating the ascosporous form of yeast.** <Bot. Gaz., vol. XVII, Bloomington, Ind., Mar. 17, 1892, pp. 92–93.

Describes a method used to successfully cultivate yeast spores according to a plan recommended by Hansen. (J. F. J.)

1290. Atkinson, Geo. F. **An automatic device for rolling culture tubes of nutrient agar-agar.** <Bot. Gaz., vol. XVII, Bloomington, Ind., May, 1892, pp. 154–156, pl. 1, fig. 1.

Describes method of making an apparatus for keeping culture tubes in motion. (J. F. J.)

1291. Chester, F. D. **A new culture cell.** <Micros. Bull., vol. IX, Philadelphia, Aug., 1892, pp. 25–26, fig. 1.

Describes a cell designed by N. A. Cobb for the study of the growth of microscopic fungi. (J. F. J.)

1292. Russell, H. L. **The effect of mechanical movements upon the growth of certain lower organisms.** <Bot. Gaz., vol. XVII, Bloomington, Ind., Jan. 20, 1892, pp. 8–15.

Describes apparatus for experiment and gives details of the results. The species experimented with were *Monilia candida*, *Oidium albicans*, and *Saccharomyces mycoderma*. The results showed more rapid growth in the agitated than in the stationary flask, but a greater amount of alcohol was found in the latter than the former. The increase in growth in the agitated flask is apparently due to more perfect aeration and better nutrition. (J. F. J.)

ERRATA.

On page 215 the following corrections should be made in table 6, in the column giving "Weight of straw and grain:"

Line.

1, *instead* of 23 *read* 22.
2, *instead* of 23 *read* 22.
3, *instead* of 24 *read* 23.
7, *instead* of 31 *read* 30.
9, *instead* of 17 *read* 13.
10, *instead* of 33 *read* 34.
11, *instead* of 29 *read* 28.
12, *instead* of 24 *read* 23.
13, *instead* of 15 *read* 14.
17, *instead* of 20 *read* 19.
18, *instead* of 25 *read* 24.
19, *instead* of 32 *read* 31.

GENERAL INDEX.

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INDEX TO HOSTS.

INDEX TO FUNGI.

n. s. following a name indicates a new species, i. e., one described in this volume; *syn.* denotes a synonym.

A.

B.

E.

F.

G.

H.

U. S. DEPARTMENT OF AGRICULTURE.

DIVISION OF VEGETABLE PATHOLOGY.

PERIODICAL BULLETIN. Vol. VII.

THE

JOURNAL OF MYCOLOGY:

DEVOTED ESPECIALLY TO THE STUDY OF FUNGI

IN THEIR RELATION TO PLANT DISEASES.

EDITED BY

THE CHIEF OF DIVISION AND HIS ASSISTANTS.

PUBLISHED BY AUTHORITY OF THE SECRETARY OF AGRICULTURE.

WASHINGTON:

GOVERNMENT PRINTING OFFICE.

1894.

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